PROCEEDINGS

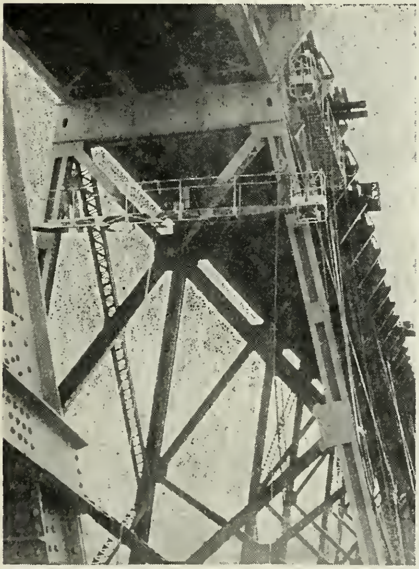
Seventieth Annual Convention

OF THE

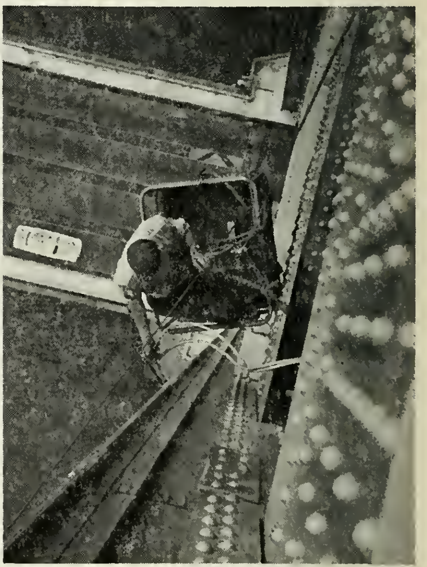
American Railway
Bridge & Building Association

1965

THE HIGH ROAD—Painting as he goes this painter walks a Spider Staging along a main cable of the Chesapeake Bay Bridge.



40% SAVED—The Chicago and North Western Railroad, through the use of modern material and equipment, reduced their bridge painting costs by 40%.



FROM TOP TO BOTTOM—A bird's eye view of a Tower painter in a Spider Staging, 550 feet above Puget Sound, on the Tacoma Narrows Bridge.

RENTAL AND SALES

Spider Staging Sales Co.

235 Airport Way Renton, Washington 98055
PHONE ALpine 5-8267

Proceedings of the

Seventieth Annual Convention

of the

American Railway
Bridge & Building
Association

Held at

CHICAGO, ILLINOIS

September 13–15, 1965

Published by the Association
Ruth Weggeberg, Secretary
220 So. Michigan Ave., Chicago 4

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1799

PROCEEDINGS

The Event—The 70th Annual Convention of the Bridge and Building Association
The Date—September 13–15, 1965
The Place—Conrad Hilton Hotel, Chicago, Ill.

President R. C. Baker presided over separate sessions of the B&B convention.

The 70th annual convention of the American Railway Bridge and Building Association was held on September 13–15, 1965, at the Conrad Hilton Hotel, Chicago. As in past years, the convention was held in conjunction with, although separate from, the Roadmasters' and Maintenance of Way Association of America, with the exception of two joint sessions.

Total attendance at the conventions was 938, including 510 railroad members of the associations, 137 associate members and 291 guests, plus 173 ladies. Registered members of the Bridge and Building Association totaled 304 railroad members and guests. There was no exhibit of work equipment held in conjunction with the meetings.

These proceedings give abstracts of two of the major addresses delivered during the joint sessions of the conventions, virtually the full text of two others and the full text of the reports of the five B&B special subjects committees and two special features of the B&B sessions. In addition, the proceedings include the directory of members, the constitution and by-laws of the association, and other pertinent current and historical information.

As usual in a non-exhibit year, two joint sessions were held during the conventions—the first on Monday morning, September 13, and the second on the following morning. The joint session on Monday was the opening meeting of the conventions and featured addresses by D. O. Mathews, president, Chicago & Eastern Illinois, and Earl Oliver, director of personnel (now vice president of personnel), Illinois Central.

Mr. Mathews' talk was entitled "What Price Regulation;" Mr. Oliver's was "Protection—People or Jobs?"

The second joint session included addresses by R. D. Shelton, vice president —operations, Atchison, Topeka & Santa Fe, who spoke on "Railway Operations and the Maitnenance-of-Way Supervisor;" A. V. Johnston, chief engineer, Canadian National, who described "Maintenance-of-Way Training on the Canadian National Railways;" and C. E. Neal, vice president and general manager, Northwestern Pacific, who showed a color motion picture on the extensive flood damage to the NWP in December 1964 and some of the later restoration.

B&B Separate Sessions

Separate sessions of the Bridge and Building convention were held on Monday and Tuesday afternoons and Wednesday morning and were presided over by President R. C. Baker, assistant chief engineer, Chicago & Eastern Illinois. During these sessions the following special subjects reports were presented:

Training Bridge and Building Supervisors
Steel Railway Bridges—Methods of Protection from Corrosion
Prestressed Concrete Uses in the Railway Industry
Advantages and Disadvantages of Prefabricated and Portable Buildings
Timber Trestle Maintenance, Procedures and Equipment

The Monday afternoon separate session featured an illustrated address on "Weathering Steel in Bridges," by A. A. Hoffman, sales engineer, Bethlehem Steel Corporation. The afternoon session the following day included two illustrated special features—one by F. V. Koval, assistant to president, Chicago & North

Western, on "Modernization of Suburban Stations on Chicago & North Western;" the other by J. W. Storer, vice president, Osmose Wood Preserving Company of America, Inc., on "Facts and Fantasies of Timber Trestle Inspections."

During the final separate session of the convention, held on Wednesday morning, G. M. Magee, director of engineering research, Association of American Railroads, gave an illustrated talk on "Problems Created by Butt-Welded Rail Laid Across Bridges—and What to do About Them."

Remarks by President Baker

The presidential address of the B&B convention was delivered by President Baker at the Monday afternoon separate session. His talk included the following remarks:

I am very thankful for the privilege of presiding over your Association's Seventieth Convention. Sixty-five years ago another employee of the C&EI, A. S. Markley, presided over the Tenth Convention of this Association. Records indicate that the membership at that time was 143. As of June this year our total membership in all classes was 876, 650 of these being active members.

It is quite interesting to review some of the proceedings of the conventions held in the early 1900's. The reports and discussions were very thorough and provided a means for its members to learn of new methods and materials for improving the quantity and quality of their work. Today the railroads are confronted with competition that was practically unknown 65 yeras ago when manpower was plentiful. Our problem today is to find new methods and new equipment to overcome our mounting labor and material costs.

We have come a long way since the early 1900's but there is much yet to be done.

Labor costs are almost prohibitive today and our source of supply for maintenance employees gets smaller, and certainly there is no choice or selection. So where do our future foremen, mechanics and machine operators come from?

Certainly, we do not wish to discourage our youth of today from striving for a college education, however, we have to face the facts. Recently there appeared in one of our Chicago newspapers an article written by its labor correspondent entitled "Help Us Mama and Papa." This article told of the shortage of mechanics and other tradesmen in the transportation industry, including the railroads. The recruiters from these industries are making efforts to recruit apprentices and this is their sales pitch to parents: "College isn't the only way to success for your sons. Executives, supervisors and other management men can come up through the apprenticeship system, earning money while in training". Therefore, it becomes the duty of all of us to be on the alert for future developments in our labor problems.

There are and will be other problems facing us which we will need to analyze and find a workable solution. One way to do this is to meet with others in our field to exchange views and discuss mutual problems.

Our active membership in June 1964 was 680, 30 more than June of this year. We must all work diligently to keep our membership at the proper working level, which is approximately 700 active members. I urge you to take an active part in your Association. Volunteer for committee work.

During the past year one of our past presidents developed some interesting facts on the frequency with which certain related subjects appeared on the list of special committee reports. As a result he made a recommendation that your Association have standing committees on certain subjects. This recommendation was given to our Special Subjects Committee for consideration. The recommendation of the committee, which was endorsed by the Executive Board, was that henceforth the Association have two standing committees. These are:

1. Materials for B&B Work
2. Tools and equipment for B&B Work

Accordingly, the number of Special Subjects Committees will be reduced to four.

Your Association today remains solvent and active. You have a fine group of young men on your Executive Board to lead you in the years ahead. Give them your unlimited support and you and your Association are sure to prosper.

Election of Officers

The following were elected officers of the B&B Association for 1965–66:

President—H. M. Wilson, supervisor of structures, Pennsylvania, Chicago, who was advanced from first vice president; First Vice President—R. D. Hellweg, assistant regional engineer, Gulf, Mobile & Ohio, Bloomington, Ill., who was promoted from second vice president; Second Vice President—J. W. De Valle, chief engineer, bridges and structures, Southern, Atlanta, Ga.; Third Vice President—W. F. Armstrong, engineer of buildings, Chicago & North Western, Chicago. Both Messrs. De Valle and Armstrong had been serving as directors of the Association.

E. F. Snyder and Mrs. Ruth Weggeberg were re-elected treasurer and secretary, respectively.

New directors of the Association elected for three-year terms are: J. S. Ellis, supervisor of bridges and buildings, Chesapeake & Ohio, Grand Rapids, Mich., and T. L. Fuller, engineer of bridges, Southern Pacific, San Francisco, Calif. Mr. Ellis was a director, serving out an unexpired term.

New Committee Subjects

Since two standing committees have been organized by the association, the 1966 convention will see six assignments reported on—two standing and four special.

The special assignments are:

1. Updating and Maintaining Railroad Track Scales.
2. Treating Wastes for Mechanical Terminals.
3. Methods of Replacing or Repairing Failed Culverts.
4. Repairs to Steel Bridges (To include welding, special fasteners and minimum traffic interference)

Each of these commitees will report its findings on September 26–28, 1966, at the Conrad Hilton, Chicago.

SECRETARY'S REPORT

ANNUAL REPORT ON MEMBERSHIP FOR PERIOD SEPTEMBER 12, 1964 TO SEPTEMBER 12, 1965

ACTIVE MEMBERSHIP:			
Total Active Members, September 12, 1964		637	
New Active Members since September 12, 1964		60	
Reinstated—Paid back dues		5	
		702	
LESS—Resigned account retirement, etc.	28		
Members reported deceased	7		
Transferred from Active to Associate	2		
Transferred to Life Membership	8		
Dropped for non-payment of dues	41	86	
TOTAL ACTIVE MEMBERS—SEPTEMBER 12, 1965			616
ASSOCIATE MEMBERS:			
Total Associate Members, September 12, 1964		103	
New Associate Members since September 12, 1964		9	
Transferred from Active to Associate Membership		2	
		114	
LESS—Resigned account retirement, etc.	2		
Members reported deceased	1		
Dropped for non-payment of dues	17	20	
TOTAL ASSOCIATE MEMBERS—SEPTEMBER 12, 1965			94
LIFE MEMBERS:			
Total Life Members, September 12, 1964		115	
Transferred from Active Membership since September 12, 1964		8	
		123	
LESS—Reported deceased		9	
TOTAL LIFE MEMBERS—SEPTEMBER 12, 1965			114
HONORARY MEMBERS:			
Total Honorary Members, September 12, 1964		5	
TOTAL HONORARY MEMBERS—SEPTEMBER 12, 1965			5
TOTAL MEMBERSHIP—ALL CLASSES—SEPT. 12, 1965			892

TREASURER'S REPORT

SEPTEMBER 1, 1964 TO AUGUST 31, 1965

Cash Balance—August 31, 1964			$1,090.08
RECEIPTS:			
Dues—1966	$1,384.50		
Dues—1965	2,378.00		
Dues—Prior	176.00	$3,938.50	
Advertising:			
1963–64 Proceedings	$2,665.75		
Sale of Proceedings	12.00	2,677.75	6,616.24
Total Receipts			$7,706.33
DISBURSEMENTS:			
Salaries (Secretary and Assistant)		$2,244.02	
Social Security		70.00	
Stationery and Printing		501.30	
Postage		319.70	
Office Rent, Telephone, Electricity		287.68	
1964 Proceedings		1,887.34	
Convention Expenses		169.07	
Office Supplies		33.97	
Embossing Membership Plates		39.63	
Miscellaneous		39.26	5,591.87
Balance, August 31, 1965			$2,114.36
Cash on hand First National Bank of Chicago, August 31, 1965			$2,114.36

September 7, 1965

APPROVED:
H. D. Curie
W. H. Huffman
W. A. Buckmaster

E. F. SNYDER, *Treasurer*

REPORT OF AUDITING COMMITTEE

TO MEMBERS OF THE
AMERICAN RAILWAY BRIDGE & BUILDING ASSOCIATION:

Gentlemen:

The undersigned have examined the books of the Secretary and report of the Treasurer for the period from September 1, 1964, to August 31, 1965, inclusive, and have found them to be correct as of the latter date.

Respectfully submitted,
H. D. Curie, *Chairman*
W. A. Buckmaster
W. H. Huffman

September 7, 1965

REPORT OF NECROLOGY COMMITTEE

(1964–1965)

To the President and Members of the
AMERICAN RAILWAY BRIDGE & BUILDING ASSOCIATION

We regret to advise that we have learned of the loss of seventeen (17) members through death during the year. It is possible that other members have passed away during the year of whom we have no information. If you know of any, we would like to have their names to include in the list to be printed in the Annual Proceedings. The following have been reported since our last Annual Meeting in September 1964:

NAME	TITLE—RAILROAD	YEAR JOINED	DATE DECEASED
Active Members			
C. J. Freseman	Division Engineer Chicago & North Western St. Paul, Minn.	1957	Oct. 1964
H. I. Johnson	Assistant Engineer Chicago, Milwaukee, St. Paul & Pacific Chicago, Ill.	1957	1964
H. J. Lieser	Supervisor Bridges and Buildings Chicago & Western Indiana Chicago, Ill.	1948	June 1965
R. G. McCall	Assistant Bridge and Building Supervisor Denver & Rio Grande Western Salt Lake City, Utah	1963	1965
J. J. Sharkey (Ret.)	General Foreman, Bridge & Buildings Pennsylvania Short Hills, N. J.	1951	May 1965
F. R. Spofford (Pres. of Assn. 1952–1953)	Assistant to Vice President Operations Boston & Maine Boston, Mass.	1940	March 1965
S. J. Watson	Chief Draftsman Chicago & North Western Chicago, Ill.	1960	1964
Associate Members			
E. L. Kent, Jr.	Sales Engineer Coast Paint & Lacquer Company Houston, Texas	1962	1965
Life Members			
G. M. Cota (Ret.)	Chief Clerk, Engineering Department Central Vermont St. Albans, Vt.	1913	Nov. 1964
J. E. Gillette (Ret.)	Carpenter Foreman Chicago, Milwaukee, St. Paul & Pacific Mazomanie, Wis.	1923	Aug. 1964
J. S. Hancock (Ret.) (Pres. of Assn. 1947–1948)	Bridge Engineer Detroit, Toledo & Ironton Dearborn, Mich.	1916	Oct. 1964
W. A. Huckstep (Ret.) (Pres. of Assn. 1950–1951)	General Building Supervisor Missouri Pacific LaJolla, Calif.	1941	April 1965
F. C. Huntsman (Ret.)	Assistant Engineer Wabash Macon, Mo.	1922	Jan. 1963
R. P. Luck (Ret.)	Draftsman Chicago & North Western Chicago, Ill.	1920	Oct. 1964
A. G. McKay (Ret.)	Supervisor Bridges and Buildings New York, New Haven & Hartford Groton, Conn.	1915	Dec. 1964
W. R. Roof (Ret.)	Bridge Engineer Chicago Great Western Chicago, Ill.	1927	1965
R. A. Van Ness (Ret.)	Bridge Engineer System Atchison, Topeka & Santa Fe Sebring, Fla.	1949	Sept. 1964

We deeply regret the passing of these, our fellow members. May we stand a moment in silence to honor these departed members.

Respectfully submitted,
A. R. Dahlberg, *Chairman*

September 10, 1964

REPORT OF RESOLUTIONS COMMITTEE

As we near the end of our 70th convention in the 74 years of the Association, we feel it proper to recognize special efforts and propose the following resolutions:

BE IT RESOLVED that the sincere thanks of the Association be extended first to the Reverend Dr. Kenneth Hildebrand, Pastor of the Central Church of Chicago, who invoked divine blessing and guidance on the activities of the combined associations and guests.

BE IT FURTHER RESOLVED that the thanks of the Association be extended to the Executive Officers who honored us with inspiring remarks and counsel in addressing the joint sessions, especially to Mr. D. O. Mathews, President, Chicago & Eastern Illinois Railroad; Mr. Earl Oliver, Director of Personnel, Illinois Central Railroad; Mr. R. D. Shelton, Vice President—Operations, Atchison, Topeka & Santa Fe Railway; Mr. A. V. Johnston, Chief Engineer, Canadian National Railways and President, American Railway Engineering Association; and Mr. C. E. Neal, Vice President and General Manager, Northwestern Pacific Railroad.

BE IT FURTHER RESOLVED that the thanks of the Association be extended to the following for their interesting and informative special subject presentations: Mr. A. A. Hoffman, Sales Engineer, Bethlehem Steel Corporation; Mr. F. V. Koval, Assistant to President, Chicago & North Western Railroad; Mr. J. W. Storer, Vice President, Osmose Wood Preserving Company of America, Inc.; and Mr. G. M. Magee, Director of Engineering Research, Association of American Railroads.

BE IT FURTHER RESOLVED that the thanks of the Association be extended to Mr. J. L. Beven, Jr., President, and Mr. C. J. Miller, First Vice President, Railway Engineering—Maintenance Suppliers Association, and to this Association's members for their support throughout the year, for the great convention banquet, and for the wonderful hospitality shown us during this convention.

BE IT FURTHER RESOLVED that the thanks of the Association be extended to the Conrad Hilton Hotel and staff for its many courtesies during the convention.

BE IT FURTHER RESOLVED that the thanks of the Association be extended to the Simmons–Boardman Publishing Corporation and its representatives for their valuable and excellent coverage of the Association activities; and to Mrs. Lillian Dick and Miss Pat Pietruska of the Simmons–Boardman Publishing Corporation, to Ellen Mueller, Chicago & North Western Railroad, Virginia Kardell, Pennsylvania Railroad, Mrs. Wanetta Baldwin, Chicago & Eastern Illinois Railroad and Miss Sandra Fuller, American Railway Engineering Association, who so ably assisted us at the registration desk.

BE IT FURTHER RESOLVED that the thanks of the Association be extended to Mrs. R. C. Baker and her committee, who took care of the ladies registration and reception.

BE IT FURTHER RESOLVED that the thanks of the Association be extended to the chairman and members of each committee presenting reports, which have contributed so materially to the success of this convention.

AND, BE IT FURTHER RESOLVED that the sincere thanks and appreciation be extended to our retiring president, Mr. R. C. Baker, who so ably and efficienctly directed the activities of our Association during this past year.

Respectfully submitted,
J. S. Ellis, *Chairman*
A. R. Dahlberg

SPECIAL FEATURES OF B&B SESSIONS

Four special features were presented during the three separate sessions of the Bridge and Building Association convention—one on Monday afternoon, two on Tuesday afternoon and one on Wednesday morning.

Two of these, however, were primarily slide presentations with commentary and are not presented herein. One is the discussion during the Monday afternoon session by Albert A. Hoffman, sales engineer, Bethlehem Steel Corporation, on "Weathering Steel in Bridges." The other is the talk on Tuesday afternoon on "Modernization of Suburban Stations on the Chicago & North Western," by Frank V. Koval, assistant to president, C&NW.

The other two special features were addresses augmented by slides and are included herein virtually in full. The first was delivered at the Tuesday afternoon session by John W. Storer, vice president, Railroad Division, Osmose Wood Preserving Company of America, Inc., on "Facts and Fantasies of Timber Trestle Inspections." The second is the discussion by Gerald M. Magee, director of engineering research, AAR, on Wednesday morning on "Problems Created by Butt-Welded Rail Laid Across Bridges—and What to do About Them."

Here is what the two speakers said:

Facts and Fantasies of Timber Bridge Inspection

John W. Storer
Vice President
Osmose Wood Preserving Co.

The present timber bridge inspection procedures practiced by many railroads today are grossly inadequate. That statement is made in the form of a challenge and my purpose will be served if (1) I can convince you of the accuracy of that statement and (2) I can make some reasonable suggestions on how the system can be improved. Since I am a forester by profession, and not a structural engineer, my remarks are confined to the inspection of timber bridges from the decay standpoint.

Over the past five years, I have had the unique privilege of personally inspecting timber bridges on over 40 railroads in the United States, Canada and Mexico. In each case, I was accompanied by one or more of the railroad's representatives, men who were either directly involved, or responsible for, timber bridge inspections. This afforded an unparalleled opportunity to observe and compare the varions inspection methods and procedures in current use in the industry today.

What are these current practices? As you might imagine, they do not necessarily follow the accepted procedures published in committee reports of the B&B Association or the AREA Manual. As a matter of fact, there are as many different inspection procedures as there are inspectors. As one extreme, I have seen inspection carried out strictly on a visual basis—with the principal criteria being the age of the bridge. At other times, I have seen inspection performed by highly capable and conscientious individuals who knew the condition of their bridges and had boring records to back up their recommendations.

The human element is obviously the key factor since personal judgment is, in the final analysis, the essense of bridge inspection. Unfortunately, in many cases, critical judgments or decisions are being made without the benefit of detailed field investigations. The following case histories will serve to illustrate the point:

(1) In early 1964 we were asked to cruise a 1930 creosoted pile trestle composed of 83 panels. The ballast deck had been placed in 1946. We were told that the structure was scheduled for early replacement. A three-hour inspection by two men sounding and boring proved the structure an excellent subject for in-place treatment. On completion of in-place treatment, with a detailed boring evaluation of each pile, only 11 piles, or 3.9%, were rejected and ultimately posted.

(2) In the fall of 1963, we were asked to cruise a 2,500-ft main-line ballast-deck trestle which had been constructed of creosoted pine in 1926. This bridge was budgeted for replacement in 1964 at a cost of $340,000. With two men sounding and boring for six hours, it was clearly shown that the structure was not in need of replacement and it was removed from the construction budget. This bridge was subsequently treated in-place during which an average of 100 inspection holes was bored per bent. The final report showed 58.2% of the piling had some internal decay present but only 4.4% were considered by the railroad to be below minimum strength requirements, and these were posted.

(3) A few months ago, we were asked to cruise a number of untreated trestles on a marginal branch line where a considerable amount of repair and replacement work was scheduled in the near future. Sounding and boring clearly proved that one bridge scheduled for redriving was in better condition than most of the others inspected. Conversely, a bridge we found to be in need of replacement was scheduled for a minimum of repairs.

(4) Recently, while cruising a mainline ballast-deck trestle, we found one bent with three reject piles out of six.

Needless to say, a B&B gang put in some overtime posting three piles that same evening.

(5) In another case, we inspected a small seven-panel open-deck trestle at the request of the B&B supervisor while in his territory on other cruising work. The bridge had been scheduled for redriving several years before and the replacement timbers were still on the site. This individual had bored the piling, knew they did not need to be replaced—and had been stalling the redriving. Our inspection verified what he already knew—the bridge was in excellent condition with only one reject pile. Why was this bridge scheduled for redriving? In attempting to find the answer, we learned that the bridge had been driven in 1914 and was the oldest in that district. We can only surmise that the inspector, seeing the one bad pile, and knowing the bridge was old, assumed the rest of the piles must be decayed internally, and therefore recommended replacement. The fact that this was high-speed, main-line track undoubtedly influenced the decision to replace the structure.

Condemning a bridge because of a few obviously reject members has occurred more times than most of us would want to admit.

Unfortunately, these are not just isolated cases to be classified as "odd-ball situations." The fact is that many railroads are not renewing their worst bridges—and, in many cases, I have observed bridges in good structural condition being replaced on that same property. With today's highly competitive situation in the transport industry, no railroad can afford to cut out piles or replace bridges prematurely. By the same token, today's heavier loadings make it imperative to replace any member whose condition places it below your minimum strength requirements.

What are some of the reasons for these errors in judgment? First, is the obvious fact that it is many times physically impossible for the men responsible to spend adequate time at each bridge to make a thorough inspection. There are simply too many bridges and not enough time. Due to this time factor most inspections today are carried out by a combination of visual observations and sounding.

Visual inspection is important, but it must be followed by a physical inspection of those members that look suspicious. I remember distinctly one bridge where the ballast deck had been marked for replacement merely because of discoloration of the stringers. They looked bad. A subsequent boring inspection proved the deck to be in excellent condition and that the discoloration was caused by local air pollution.

Visually, a pile may appear to be questionable, but after all decayed sapwood is removed the pile actually may be in good condition, with perhaps 90% or more of its original bearing capacity remaining. Visual impressions can be deceiving.

Hammer sounding is by far the most common inspection method used and is vital as a means of locating suspect members. However, there have been more good piles cut out of bridges based on hammer soundings than for all other reasons combined. Fig. 1 shows a typical decay pattern in Southern yellow pine where the decay spores entered through a check or split and decay developed at the junction of the creosoted shell and the untreated heart. A hammer sounding of such piles will invariably lead to their being marked for posting—*unless* a boring inspection is made to ascertain the exact condition. What is misleading is the fact that the sound waves vibrate in the decay pocket and the result is a definite "hollow" or "base drum" sound.

Sounding is also extremely misleading where piles have been overdriven and the annual rings have become separated. Again, the pile sounds decayed or hollow and is apt to be replaced without a more detailed investigation.

In my opinion, sounding without boring those members sounding suspicious is less than 50% accurate. And further, if a shell thickness is found to be less than 3 in. in a pile a second boring should be made into the void area at a 90-deg angle. Otherwise, many piles perfectly capable of supporting the load will be condemned for lack of a second boring.

Errors in judgment based on observations in the field are only one aspect of the problem. Other errors result from various misconceptions which I prefer to call the fantasies of timber bridge inspection. The accompanying tabulation lists some of the fantasies—and the facts.

My recommendations for improved inspection procedures can be summarized as follows:

(1) *Sound* all timber possible—with special attention given to locations likely to trap moisture. In piling, we find most decay in the drift-pin, groundline, and brace-bolt locations. In caps, we find it at the bearing points and along drift pins or through bolts. Stringers can and do develop decay in the middle of the span but this is not common. Most stringer decay is confined to the cap bearing locations and along bolts. Areas alternately wet and dry are most vulnerable to decay.

(2) *Power bore* all timber where sounding indicates possible internal decay. Bore

FANTASIES	FACTS
(1) "The bridge is old and should be replaced."	Age, as such, means nothing. We have treated the piling on a number of 50-year-old-plus structures and many of these are in superior condition to other bridges half that age.
(2) "The treatment is all bleached out and timber is badly checked. It looks bad."	Don't condemn a bridge before boring.
(3) "Caps always crush before geting dangerous."	Don't count on it. We have located many dangerous caps in our work that could be found only by boring.
(4) "It sounds bad and should be replaced."	Bore it first.
(5) "That's old heart pine and we never have trouble with that."	Don't count on it.
(6) "We can't have any decay below ground."	Excavate a percentage of piles at least 2 ft and be sure.
(7) "These piles remain in water all the time and we don't have a decay problem."	Better check about 2 ft or 3 ft above the water-line where wick action ends and decay conditions are just about perfect internally.
(8) "All of our bridges are treated and we don't have a decay problem."	Ninety percent of our business is the treatment of treated bridges.
(9) "We do have some center rot but it doesn't affect the treated shell."	Decay can and does take place in the treated area. It is strictly a matter of whether or not the preservative retention is above or below the threshold level for that particular decay organism.
(10) "I'm not concerned about that branch—we rebuilt all the trestles during World War II."	Some railroads are already redriving World War II bridges. Our experience indicates that all bridges treated from 1941–1946 are suspect—until proven innocent. Many bridge timbers simply did not receive proper treatment during the war period, due to inadequate seasoning. In addition, it was often necessary to accept timber of inferior quality.

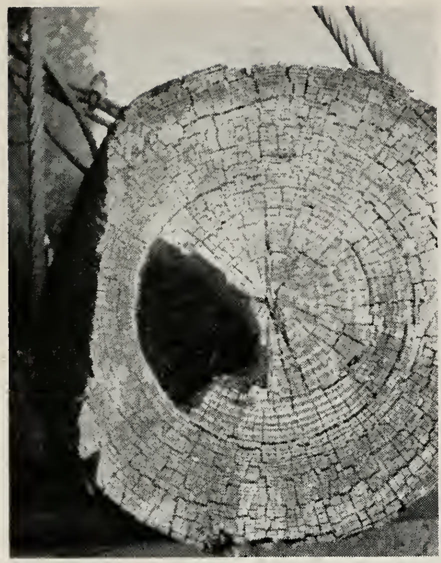

Fig. 1—Hammer sounding of this pile would emit a definite "hollow" sound from decay pocket.

the first hole into that point which sounds the most suspicious. If the shell is found to be less than your minimum requirements, additional inspection holes should be bored, placing the second hole at 90 deg to the first. All inspection holes to be plugged with treated dowels.

(3) *Measure* the shell thickness and voids and record the information on an appropriate form. It is most important to measure the void as well as the shell thickness to evaluate minimum and maximum conditions. Shell thickness indicators are commercially available for this purpose.

I realize that boring has been recommended as standard procedure over the years. However, boring with a brace and bit was time-consuming and difficult. Certain railroads attempted to standardize on increment boring but this was not practical due to the rapid blunting of the cutting edge in boring weathered bridge timbers. The boring equipment we have found best suited for bridge inspection is a ⅜-in or ½-in electric drill operated off a portable generator or a 12-volt battery system. These units are completely portable, have enough charge for a full day's boring, and are fully recharged by plugging into any 110-volt outlet overnight.

The July, 1965, issue of *Railway Track and Structures* carried a reply from H. Bober, bridge and building engineer, Gulf, Mobile & Ohio, to the question: "Are present bridge inspection practices adequate in view of the increased wheel loads?" Mr. Bober points out the comparative effect of 315,000-lb cars in relation to the 210,000-lb cars used previously. The table given shows a 57% psi increase in the bearing of stringers on caps, a 57% psi increase in bearing of caps on piles, and a 56% increase in the load per pile—from 8.7 tons to 13.6 tons.

Your present timber trestles are really remarkable structures, and, in the past, had a considerable margin of safety. But, with the present heavy cars, stresses are close to the maximum allowable. Since this allowable stress is based on *all timber being in good condition,* it is vitally important to discover, on inspection, any decay or defects, and to measure the extent of deterioration as accurately as possible.

Problems Created by Butt-Welded Rail Laid Across Bridges—and What to Do About Them

Gerald M. Magee
Director Engineering Research
Association of American Railroads

As you made the train trip (I hope) from your home to Chicago to attend this convention, I am sure that you missed the old familiar sound of the clickety click as your car traveled over the rails. Being railroad men it is not necessary to go into details explaining why and how the advent of continuous welded rail has reduced the "clickety click" to an occasional "click."

The use of continuous welded rail is not new as you know. Our records indicate the first installation of continuous welded rail in open track in the United States was made on the Delaware and

Hudson Railway near Albany, New York in 1933. Since that time, thousands of miles of such rail have been laid. Everyone knows that continuous welded rail is practical and works under extreme temperature changes but still many people ask "Where does the expansion go and what do you do about it?" For this reason, we felt it desirable to discuss the basic principles of welded rail action under temperature changes before discussing the use of such rail on bridges.

The action of continuous welded rail in track under various temperature changes is based on two fundamental engineering principles. The first principle is that steel is elastic and if we apply a force to the 1-in steel cube, a definite deformation or strain will take place. Research has shown that the magnitude of the strain is directly related to the force so that if the force is increased by a factor of say 2, the strain is doubled. This relation, which holds true up to the yield point of the steel, is defined as the Modulus of Elasticity "E" and is equal to the stress "f" divided by the strain "Δ". It is interesting to note that this ratio is very close to 30,000,000 lbs per sq inch and is the same for all types of steels. Incidentally, the minimum yield point of rail steel is 70,000 lbs per sq in.

So far we have been discussing the strain in a 1 in steel cube but the same relation exists for any steel member of other cross-sectional areas. By using the unit stress "f" which is equal to the total force "F" divided by the area "A" of the section, the strain "Δ" in the member per inch of length is then equal to the force "F" divided by the area "A" times the modulus of elasticity "E" or $F = \Delta AE$.

If a force "F" of 50,000 lb is applied to the 1 in cube, the following results are:

The stress "f" is 50,000 lb divided by 1 sq in or 50,000 lb per sq in.

The strain "Δ" is 50,000 lb per sq in divided by 30,000,000 lb per sq in which equals 0.001667 in. If a 1 in square bar, 10 in long is subjected to the force of 50,000 lb., each inch of its length will reduce 0.001667 in. in length so the total reduction in length will be 10 times 0.001667 in or 0.01667 in.

The second fundamnetal engineering principle involved in continuous welded rail is that steel will change its dimensions with a change in temperature of the steel. Research has shown that all steels will change their dimensions 0.0000065 in per in of length per 1 deg fahrenheit change. Thus a steel bar 1 in long will elongate 0.0000065 in when the temperature change increases 1 deg. A steel bar 10 in long will increase 0.000065 in. in length with a 1 deg temperature increase. A steel bar 1000 in long will increase 0.65 in. in length with a 100 deg temperature increase.

With this background of the relation between stress and strain and the changes in lengths of members resulting from temperature changes, the principles can now be applied to long steel bars or steel rails. If 37 rails, each rail 39 ft long, are welded together, we have a steel rail 1,443 ft or 17,316 in long. If the temperature of this rail is increased 75 deg and we assume the rail is resting on frictionless rollers, the length of the rail will increase 4.22 in at each end for a total increase of 8.44 in. This increase in length is calculated as follows:

> 17,316 in. in length times 75 deg temperature change times 0.0000065 temperature coefficient = 8.44 in.

We now find that our rail is 8.44 in too long but we also know from our relation between stress and strain that the rail can be shortened by applying compressive forces "F" on the ends of the rail. We have previously shown that the strain "Δ" equals the force "F" times the length in inches divided by the product of the area "A" of the section and the modulus of elasticity divided by the length in inches. For a 132 lb RE rail, having an area of "A" of 12.95 sq in, the force required to strain the rail 8.44 in equals 189,270 lbs as shown. The stress "f" in the rail is then the force "F" divided by the area "A" which equals 14,615 lb per sq in.

Instead of permitting the rail to expand 8.44 in and then applying a force of 189,270 lb to compress the rail back to its original length, suppose we place the 17,316 in long rail between two immovable abutments. As the temperature of the rail increases, the force between the immovable abutments and rail ends increase and with a 75 deg increase, the force on the ends of the rail equal:

> Force "F" = Area "A" times Temperature Change "T" times coefficient of expansion times modulus of elasticity "E" equals 189,270 lb, the same force "F" required to compress the rail 8.44 in.

The compression stress in the rail under a force "F" of 189,270 lb is then 14,615 lb per sq in. A convenient relation to remember is that if the rail is fully restrained, a temperature change of 1 deg F will produce a stress of 195 (or say 200 psi) which is the product of the 30,000,000 modulus of elasticity and 0.0000065 temperature change coefficient.

The general practice in laying welded rail is to place the rail ends together without any gap between the rails. Since the temperature changes in the adjoining rails can be assumed to be the same as the rail under discussion, the adjoining rails act as immovable abutments with a force "F" of 189,270 lb acting on the ends of the rail when the temperature increases 75 deg. As previously shown, the stress in the rail under a 75 deg temperature increase is 14,615 lb per sq in and is uniform throughout the entire length of the rail. A 100 deg temperature increase will produce a stress of 19,490 lb per sq in. in the rail.

So far we have been discussing the forces, stresses and strains in the continuous welded rail resulting from an increase in temperature. Since steel is elastic and has approximately the same modulus of elasticity in tension as in compression, a drop in rail temperature will produce the same magnitude of stresses and strains but of opposite sign or direction as an increase in temperature, provided the ends of the rail are held in place.

Some railroads are field welding the joints between the quarter-mile lengths of rails and for this condition each quarter-mile length of rail is completely restrained from end to end without any longitudinal movement. Other railroads are using joint bars between the quarter-mile lengths and depending on joint bar and rail anchor restraint to restrain the ends of the rail. Naturally this same method of restraining the ends of the rails must be depended on to anchor the last end of the long welded rail sections.

We can now determine the number of ties required to restrain the ends of a 132 lb welded rail section resulting from a 75 deg decrease in temperature. We have previously shown that the Force "F" in the fully restrained rail is 189,270 lb but with joint bars and rail anchors this force reaches such a magnitude only in the center portion of the quarter-mile section. If we assume that the joint bars will carry a force of 75,000 lb before slipping, the ties must then carry a force of 189,270 lb minus 75,000 lb or 114,270 lb. If we assume that each anchored tie is capable of carrying an average force of 600 lb per rail, we find that 190 anchored ties are required to develop the 114,270 lb. With the ties spaced at 20 in centers and each consecutive tie anchored, we note that the rail will be fully restrained in 8 rail lengths. In other words, the joint bars will produce a force of 75,000 lb in the end of the rail and the ties will gradually increase this force for 8 rail lengths; consequently, the force in the 21 rails in the center section will remain constant at 189,270 lb.

We have shown that the force in the quarter-mile rail remains constant at 189,270 lb for its entire length with a 75 deg temperature increase when the rail ends are laid tight without any gap and, consequently, there is no movement of the rail from end to end. With a decrease in rail temperature on track where joint bars are used the quarter-mile rail becomes fully restrained gradually over 8 rail lengths and some rail end movement will therefore occur. The magnitude of this rail end movement is equal to the square of the force "F" in the rail minus the joint bar restraint "J", with the product multiplied by the tie spacing "S" and divided by the product of two times the average tie restraint "T" times the area of the rail "A" times the modulus of elasticity "E". It can be seen that the quarter-mile rail will shorten by 1.12 in or each end will move 0.56 in.

As you know, the rail joints are designed to permit a ⅜ in gap and any opening beyond this amount can be obtained only by bending the bolts, which is, of course, not a desirable condition. Experience has shown that the actual joint-gap openings between quarter-mile long rails are not as large as the computed value of 1.12 in. The joint restraint can be increased by keeping the bolts very tight and limited data from research indicates that the resistance of ties to movement in the ballast is not uniform but increases with the amount of movement. Thus, the tie restraint toward the end of the rail is probably greater than 600 lb where the amount of rail movement is greater. It would be expected that the shearing strength of the ballast on a plane with the lower surface of the tie would be increased if the ballast was frozen and this would tend to increase the tie restraint; however, no data is available on the tie restraint under these conditions. Naturally, any increase in joint bar restraint or tie restraint would reduce the movement of the end of the rail.

We hope that we have given you a clear picture of the forces and movements involved in continuous welded rail under temperature changes and undoubtedly you are now asking the question "What is the effect of such forces and movements on bridges?"

Suppose we place welded rail over an open deck timber trestle of one span without rail anchors and with the bolted rail joint 8 rail lengths past the end of the trestle. It is obvious the rail over the trestle will not have any movement resulting from temperature changes but we do have to consider any elongation of the stringers due to thermal changes. The coefficient of expansion for fir is approximately 0.0000025 in per in per deg, about 40 percent that of steel. The movement of the end of the stringers with respect to the rail resulting from a 75 deg temperature change is equal to the coefficient of expansion 0.0000025 times one half the span length in inches or 168/2 as elongation can occur both ways times the temperature change of 75 deg which equals 0.016 in. As you know, the stringers on multiple-span trestles are interlaced and bolted together and consequently, form a continuous chord from end to end. Since the stringer chord acts as a unit, the movement of the end of the chord with respect to the rail will change directly as the number of spans. For example, the elongation of a 10 span trestle will be 0.16 in while a 50 span trestle will change 0.80 in. The foregoing assumes there is no restraint to movement of the ends of the stringer chord. This probably is not the actual condition because the bents and abutments offer some restraint. The modulus of elasticity of Douglas fir parallel to the grain is approximately 1,180,000 psi so the product of this modulus and the coefficient of expansion of 0.0000025 gives a force of about 3 psi required to restrain one square inch of fir for one degree temperature change. For a 4-ply stringer bent having 8-in x 16-in stringers, this would require a restraining force of 3,066 lb per deg or 230,400 lb for a 75 deg temperature change. Also, it should be noted that a slippage at the ends of the stringers of only 0.016 in (or 0.032 in if the stringer is continuous for two bents) would provide for the expansion movement.

To my knowledge, no measurements have been made on the end movements and it would be of interest if those of you who have an opportunity to do so would make observations of this.

If the welded rail were anchored to the ties on a timber trestle with the bolted joint near the end of the trestle forces of considerable magnitude would be exerted on the trestle by a 75 deg temperature change. If we were to assume that the ties, with some of them fastened to the chord with lag screws and connected by dapped curb timbers, would have a resistance of 600 lb per tie per rail, the one span shown would be subjected to a force of 7,200 lb. This force would be resisted by bending in the piles and passive resistance of the fill back of the dump planks.

The ability of the piles to resist this force would depend upon their size, number, and height above ground line. If a broken rail should occur during cold weather on a trestle having continuous welded rail anchored to the ties, somewhat greater forces would be exerted on the bents to resist the rail ends pulling apart at the break, because with this condition there would be no joint restraint.

We have shown the action of continuous welded rail on a timber trestle with a relatively low coefficient of expansion. We will now see what happens with continuous rail placed over a long steel span permitted to elongate at one end only. We have shown that the 21 rails or 819 ft of the center section of the quarter-mile rail will not move under temperature changes; however, the expansion end of the steel span is not restrained so it will move under the rail. The relative movement of the end of a 100 ft span and the rail under a 75 deg temperature change is computed as 0.58 in and that of a 500 ft span as 2.90 in. Certainly a movement of 2.90 in could not be permitted if the rail was anchored to the ties but possibly a movement of 0.58 in would not cause any trouble. As you know, the ties on a deck girder span are resting on the top cover plates and are usually not fastened securely to the top flange, except to provide resistance against lateral movement. In general, the ties are dapped to provide for the camber and cover plate cutoffs so they should be able to move ½ in each way on the steel. As a minimum, the rail could be anchored to the ties over part of the span at the fixed end.

I am sure you remember the wood watertanks with steel bands that were located along the right-of-way during the days of the steam locomotives. The interesting part is that the steel bands were designed to place a radial force on the wood to resist the water pressure. A reference to any text book on elasticity or internal pressure will show that the magnitude of the radial pressure "P" varied with the force "F" in the steel band. We find that the force "F" in the steel band is equal to the radial pressure "P" times the radius of the band. We also know that the force in a fully restrained steel band or rail is equal to the coefficient of expansion times the modulus of elasticity times the temperature change "T" times the area "A". Since the coefficient of expansion times the modulus of elasticity is 195, the force "F" equals 195TA. Consequently, since $F = PR$, the radial force per foot of rail $P = 195TA$ divided by R. To change R to D, use may be made of the relation R is equal to 5730 divided by the degree of curvature "D". If the steel band or rail has an area "A" of 12.95 sq in we can see that the radial pressure "P" equals 195 times 12.95 sq in times temperature change "T" times degree of curve "D" divided by 5730 or "P" per foot of rail equals 0.441DT.

We now have the equation to compute the lateral forces produced by welded rail on curved track so lets determine the forces on a pile bent for various degrees of track curvature. The total force carried by one pile bent is equal to the number of rails times span length times 0.441DT or 12.33DT. For a temperature change "T" of 75 deg, the load carried by each pile bent equals 925D. It can be seen that a pile bent under a 1 degree curve will be subjected to a lateral force of 925 lb while a 10 deg curve will produce a lateral force of 9250 lb for a 75 deg temperature change. The ability of the pile bents to resist such lateral forces will depend upon the characteristics of the bent. The lateral resistance of each pile bent will vary depending on the height of the bent, the number of piles, the point of fixity in the ground and the sway bracing. It should be pointed out that even with bolted jointed rail a force of 75,000 lb can be carried by each joint. For a 6-deg curve, this would provide a lateral force per bent of 2200 lb or approximately 40 percent of that with continuous welded rail and a 75 deg temperature change.

In conclusion, we hesitate to make any recommendations for the use and anchorage of welded rail on bridges as the subpect is very complicated and more information should be obtained. However, welded rail is being used on bridges and the following observations may be helpful during this pioneer period:

(1) The action of welded rail on bridges is probably not too much different than that of jointed rail because of the resistance to slippage of rail ends in the joint bars. Consequently, the anchorage being used for jointed rail may be useful as a guide.

(2) On ballasted deck bridges, of any types, it would seem that welded rail could be used and anchored in the manner used for open track and no consideration need be given to locating the rail joint off the bridge.

On trestles on sharp curves, and particularly on high trestles, calculations should be made of the additional lateral forces imposed on the bents by the welded track and the ability on the bents to withstand such forces.

(3) On open deck bridges, it would seem that the welded rail could be used on timber, concrete, or steel beam trestles for any length of bridge with the same anchor pattern as used on open track if the rail joints fall 200 ft off of the bridge. For any rail joints on the bridge, a spring type anchor that would permit rail slippage with restraint, used for 200 ft each side of the rail joint would allow for a limited rail movement without damaging the bridge ties. Study should also be made of the lateral forces exerted on the bents on sharp curves.

On open deck viaduct spans, it would appear desirable to anchor every tie for 200 ft each side of any rail joint that falls on the span with two such rail spring clips and elsewhere anchor alternate ties with two such rail spring clips. Box anchoring of every tie for 200 ft at each end of the bridge would isolate any rail movement on open track from the bridge.

On open deck truss spans, it would seem desirable to box anchor each tie in the open track for 200 ft at each end of the span. For spans up to 250 ft it would probably be satisfactory to use no anchors on the bridge except for perhaps two rail lengths at the fixed end and leave the span free to expand and contract at the expansion end. For longer truss spans, expansion joints could be provided in the rails at the expansion end and every second or third tie box anchored on the span. It does not seem to me that welded rail on long truss spans will be affected much more by the movements at the expansion end of the truss than jointed rail and can perhaps be handled in the same manner as jointed rail.

ADDRESSES DELIVERED BEFORE JOINT SESSIONS

The first featured speaker at the opening joint session on Monday, September 13, was David O. Mathews, president, Chicago & Eastern Illinois. His address was entitled "What Price Regulation." Excerpts from his comments follow:

Remarks by D. O. Mathews

Your engineering people, of course, are not unfamiliar with governmental regulation. Your bridges across navigable waters must clear through the United States Corps of Engineers; building permits and inspections of buildings are daily encounters; zoning regulations; irrigation and drainage; district rules and regulations must also be borne.

And, of course, there is the new anti-discrimination law which may see women joining your section and bridge gangs.

Effectively enforced, street walkers may become track walkers and shortages of male help probably will disappear. Camp cars will be more attractive in all respects. But your field is probably less regulated than any other in the railroad industry. The Mechanical Department must abide by strict supervision and pages and pages of rules and regulations. Large books of rules cover the accounting functions, and personnel and labor are highly regulated.

An example of the cost of regulation is the data and reports required by the Interstate Commerce Commission in Ex Parte No. 241, *Investigation of Adequacy of Railroad Freight Car Ownership, Car Utilization, Distribution, Rules and Practices.* It is estimated that it cost the C&EI alone over $75,000 to prepare this material. The total cost to the railroad industry as a whole must have been in the millions of dollars. And the probable result of all this cost will be a finding by the Commission that there is a shortage of freight car ownership in this country!

No industry is more intimately interconnected with every facet of the nation's life than railroading. In fact, it is almost impossible to grasp the physical breadth and service depth of the plant which railroaders have built up over a century and are now rebuilding to meet the enormous, increasingly dynamic needs of U. S. commerce. For instance:

The nation's 214,000 miles of railroad right-of-way are enough to provide an entire transcontinental rail route every 17 miles from the Canadian border to the Gulf of Mexico.

Our 1,800,000 freight cars, placed end to end, would form a solid train more than 15,000 miles long, spanning the continent five times.

Our 30,000 locomotive units with their 44-million horsepower have as much power capability as all the steam-electric generating plants in 30 states and the District of Columbia.

Our 720,000 railroaders and their families are enough to populate the whole state of Washington, and their $5 billion annual payroll is one of the biggest in any single industry.

Clues to where railroads will go in the future in performing this workhorse role for America are pointed up by indicators of where the nation itself is going. Our expanding population is currently recording a net gain of three-million annually, and 40-million more people are in prospect by 1975. The nation's total output of goods and services, meanwhile, is rising at the rate of 3 percent a year, with half of this going to support our increased population and the remainder going into higher living standards. This gathering affluence also points to more vacation and travel, and even though economists foresee 100-million automobiles by 1975, the expanding travel market could hold promise of a comeback even for the hard-pressed passenger train.

Yet it's as the great burden bearer of freight that railroading shows its brightest potential for the future. If railroads only hold their present share of traffic volume moving between U. S. cities, recent economic growth trends would make their 1975 freight load one-third greater than now. And by 1988, it would double! For the further ahead we look, the clearer becomes the nation's dependence on low-cost, high-volume transportation—and this means railroads! This is why many believe railroading faces its greatest challenge right now.

One major dark cloud shadows this picture of America's changing, customer-oriented, forward-moving railroads. This is the continuing inequities confronted in outmoded, unbalanced and painfully discriminating government transportation policies. Virtually all recent Presidents and a dozen prominent public study groups have called attention to this "chaotic patchwork." In such objective views, it simply makes no sense that an industry of such vast potentials for public benefit as the railroads continues to be hampered by restrictive regulation, hurt by discriminatory taxation, then further penalized by government-promoted competition from road, air and waterway facilities which now consume over $15 billion in tax outlays annually.

The way out of this tangle has been charted in terms of "A People's Platform for Transportation." Here are its three major planks for an essential revolution in government transport policies—the door-openers to a new era of improved service, lower prices and vast tax savings in transportation:

(1) Self-support for all carriers—placing all on an equal cost and tax basis.

(2) Allowing maximum freedom for all to adjust to change—to merge, diversify, coordinate services and otherwise adapt plant and operations to new competitive conditions and customer demands.

(3) Allowing maximum freedom for all to compete on prices.

I think that there is an approach to the railroad problem which has never been fully explored. I discussed this approach with the Mechanical Division of the Association of American Railroads at their meeting here in Chicago on June 22, 1965. Consistency with my beliefs compels reiteration here. In my view railroads, like all business, are going to be regulated. The questions are what type of regulation should be applied to the railroads and who is going to regulate them. It can hardly be denied that General Motors, Ford Motor Company, General Electric, Standard Oil Company and numerous other major industries have grown and thrived without regulation comparable to that found in the Interstate Commerce Act.

These industries have been regulated by the Sherman Act and kindred acts since 1890 and notwithstanding what one reads in the papers and sometimes hears from businessmen, it cannot be denied, as I have previously noted, that other industries of this country have prospered to a far greater extent than the railroads even though they have been regulated by the antitrust laws since 1890.

I think there is a basic reason why the major industries of this country have prospered without regulation in the sense it is administered under the Interstate Commerce Act. The reason is that the Sherman Act and kindred laws are designed to make business free and to promote competition.

I respectfully suggest that the entire transportation industry would be much better off in the matter of rates and charges under the antitrust laws than it is or would ever be under the Interstate Commerce Act.

The railroads had a monopoly on transportation in 1887 and Congress brought the railroads under regulation primarily because they had a monopoly on transportation. I have read some of the legislative history and contemporary writings regarding the reasons for the adoption of the Interstate Commerce Act and if some of the things with which the railroads were charged are true, they needed to be regulated. The various sections of the Interstate Commerce Act suggest basic evils. Among these are prohibitions against unjust, unreasonable, discriminatory, preferential and prejudicial rates. Certain of these evils have been found in non-carrier industries and they have been published under laws kindred to the Sherman Act.

In 1965 the railroad monopoly no longer exists. The railroads are confronted with competition just like that confronted by General Motors, Ford Motor, Standard Oil, General Electric and Westinghouse, to name only a few companies. But the latter companies can meet competition when and as it comes into view without submitting the matter to a regulaotry body.

The railroad industry must compete with motor carriers, barge lines, air lines, power lines, pipe lines and atomic power as well as private carriage using some of these media of transportation. These competing agencies are considered daily in the rate departments of all railroads. The existence of these agencies means that the railroads are living in a highly competitive world and that the evils which caused Congress to regulate the railroads in the first place do not exist today simply because these competitive agencies provide the most effective regulation of all, that is, constant pressure which requires the railroads to meet their competition.

The railroad's position is worsened by the fact that two-thirds of truck traffic and nine-tenths of inland waterway tonnage operate free of rate regulation. The only price regulation imposed on this traffic are the antitrust laws and the figures I have cited show that this competition has thrived under the competition guaranteed by the antitrust laws. Any attempt by the carriers of this traffic to eliminate competition in pricing this business is subject to the antitrust laws, which provide criminal and civil penalties for such activities. The electrical industry learned about those penalties the hard way.

It would be politically impossible to persuade Congress to regulate this exempt traffic. Regulation of this business has been advocated for years by proponents of regulation with little, if any, success. Congress just isn't going to attempt to regulate private carriage and vast segments of for hire exempt transportation, such as bulk commodities and farm products.

More importantly, if Congress could be persuaded to do so, the job would require a horde of regulators far beyond anything yet attempted in the regulatory field. The activities of the agents sent by the British to harass the colonists were irritations compared to the impact such a horde of Government agents would have on business.

Yet if railroads are to live they must compete price-wise for this two-thirds of the truck traffic and nine-tenths of the inland waterway tonnage. The obvious way to permit them to do so is to lift the rate regulatory laws from them and impose the antitrust laws upon them.

There is a most convincing reason, in my view, why the argument that railroads need antitrust immunity in rate matters is not sound. The carriers who have taken a large share of the business from the railroads, two-thirds of truck traffic and nine-tenths of the inland waterway tonnage, have done so without antitrust immunity. I think that the railroads should ask Congress for the same treatment. I am convinced this step would save the shipping public millions of dollars in freight charges.

If protecting the public through the media of the antitrust laws is good for two-thirds of the truck traffic in this country and nine-tenths of the inland waterway tonnage, why in the name of heaven isn't it good for the railroads. In other words, would it not be better for the railroads to tell the public and Congress that we are willing to be regulated by the antitrust laws along with other industries if we can be relieved of the burdens of regulation under the Interstate Commerce Act.

The public has a real stake in the problems of the railroads. I feel that if the public understood the problem that Congress would grant relief. Regulation is manifestly unfair to the railroads because they are no longer a monopoly and because the public is more than adequately protected by effective competition.

Remarks by Earl Oliver

The second speaker at the Monday joint session was Earl Oliver, director of personnel (now vice president of personnel), Illinois Central, who spoke on "Protection—People or Jobs?" Since the address, which presented Mr. Oliver's analysis of how the February 7, 1965, job-preservation agreement affects the maintenance-of-way supervisor, is so timely and of such specific interest to members of the B&B Association, it is presented at the end of this section by itself virtually in its entirety.

Remarks by R. D. Shelton

The first speaker at the second joint session, held on Tuesday morning, September 14, was Raymond D. Shelton, vice president—operations, Atchison, Topeka & Santa Fe. He discussed "Railway Operations and the Maintenance-of-Way Supervisor." An abstract of his address follows:

Dramatic changes have taken place: Complete dieselization of power; an almost complete transition from Morse Telegraphy to teletype, radio and microwave; computerization of car and other accounting procedures; centralized traffic control and on and on—but nothing more dramatic than the changes in method of track maintenance.

Santa Fe's slogan is *"Always on the Move Toward a Better Way"*. That applies to track maintenance as well as to all other facets of our operations. Under the able leadership of such fellows as Chief Engineer System Beeder, Assistant Chief Engineer System Wilson and the Grand Division Chief Engineers, such as Jack Eisemann, Santa Fe has kept pace and in some areas has lead the way. I believe it correct to say that we have been in the forefront of stabilizing roadbeds by grouting; undertrack plowing or undercutting track as it is known by some; adopting welded rail for all main-line relay; skin-lifting out-of-face where ballast is in condition for that type of maintenance; mechanization of tie renewal operations, and in many other areas of track maintenance.

The operating man has uppermost in his mind that the railroad was chartered to run trains on and this has always permeated his thinking. Maintenance practices that retard train operation are an irritant to him but to your credit, your thinking runs also along these lines and procedures you have devised get for us maximum utilization of machines and men, coupled with minimum train delay.

Again, to your credit in your progression you have overcome the restraints of tight budgetary controls, the mistakenly resentment of new ideas—which I suppose we will always have, human nature being what it is—and the hangover of old attitudes.

Now going further with the contrast of the demands on your predecessors and you. Today in our operations we expect from you a rail design as perfect as possible for both carrying ability and quality. Rail failures of any sort or for any reasons have become too costly in delays to be acceptable.

Tie spacing, design and quality have become extremely critical.

Ballast of adequate quality, size and ability to last while maintaining track stability has become a highly important requirement.

Track fastenings, realistically designed to properly and completely perform their assigned tasks have become a prime requisite.

Improved alinement and gradients, high-speed turnouts, sophisticated signal systems all have become a requirement to modern railroad operation and this particular area calls for much greater strides.

Along side the above demands is the ever present pressure for development and growth of mechanization. It is not total, by far, as yet, but excellent considering the short development period. I accept that forward thinkers, those with great initiative and constructive imagination, many of whom are present in this audience today, provided the needed spark to start this revolutionary movement towards maximum mechanization that we are witnessing and which we so desperately need to continue to prosper.

Right here, I want to say that while the machine does the work far better than a multiplicity of individuals, the human element and human judgment remain supreme in importance; in fact, more so. I think some people tend to lose sight of this truth. The individual innovates—the individual designs—the individual programs—and the individual controls. You are those individuals. The better your judgment, the greater benefits to the railroad industry.

Railroading as we have known it in our span of experience surely can be expected to undergo such vast changes in future years as to be as virtually unrecognizable to us as is the railroad to a man with experience which terminated 50 years ago. I cannot envision the direction the changes will take. I can only envision more dependence will be upon the supervisor to effect efficiences in railway operation, that we have accomplished much to date but the surface has just been scratched and the potential is greater, that we must sooner or later have a maintenance-free railroad, that instead of a railroad with a 10-year life or a 20-year life, we must have one with a 50-year life or even longer.

The supervisor I envision will be a highly skilled, energetic technician, adequately educated, with a keen interest in the complete railroad picture, and with a desire for full exposure to all facets. The maintenance of way supervisor has always measured up to his responsibilities—I predict he will always.

I take the opportunity of this occasion to comment on the loyalty, tenacity and perserverence always in my experience displayed by the maintenance-of-way people. No greater examples of these things occurred than during this spring and summer under the most adverse conditions I can recall to memory.

We and a great number of our railroad neighbors were subjected to repeated storm and flood ravages unprecedented in our history. Mile upon mile of trackage was again and again left prostrate and countless bridges were swept away. In each instance, you exhibited the devotion to duty we all have come to expect from the maintenance-of-way employee, when anything, storm or wreck, interrupts our ability to perform service. No one rested until the lines were restored. I am cognizant of your sacrifice of time and energy in the finest tradition of your profession and welcome this opportunity to express my appreciation and I know that of other managements to you for your excellence under trying circumstances.

Remarks by A. V. Johnston

The second speaker of the Tuesday morning joint session was Alton V. Johnston, chief engineer, Canadian National, and president of the American Railway Engineering Association. He described "Maintenance-of-Way Training On the Canadian National Railways." Mr. Johnston's address is presented at the end of this section by itself virtually in its entirety due to its germane interest to members of the B&B Association.

Protection—People or Jobs?

Earl Oliver
Vice President Personnel
Illinois Central

When a member of one of your associations invited me to speak today about the February 7 job preservation agreement, I demurred. "Why not get someone who's an expert?" I said. "Why not get one of the negotiators?"

"That's not what we want," he replied. "There's been a lot of criticism of the agreement. Many of us who will be at the meeting feel we've been sold down the river. We want an analysis of the agreement, but we'd like it from a person who didn't participate in the negotiations but who has a labor relations responsibility for putting the provisions in effect."

But I did point out then, and I point out now, that what I say today is, in no way authoritative. I'm not speaking for nobody. I'm not speaking for the industry. I'm not speaking for the NRLC. I'm not speaking for the Illinois Central or even for my own department on the Illinois Central, for some of my associates hold views of the agreement that differ from my own. I'm not even speaking for myself —at least in any binding way; for I may be entirely wrong and I may change my views tomorrow. What I shall do today is simply talk about the agreement as I see it as of this moment.

I am sure our national negotiators are not a great deal happier with the agreement than you are.

How did they—how did we—get into the position of having to make an agreement such as this?

Could it be that, to some extent, the railroads brought the agreement on themselves? Could it be that there has not been sufficient thought given over the years to the employees' need for steady work and regular incomes? Does the agreement result in part from ancient practices both in the railroad industry in general—practices of planning and scheduling work with concern mainly for industry needs and insufficient thought for employee needs? Has the industry in its work scheduling placed undue weight on weather and budget, hiring large numbers of employees when the weather is good and the net profit is high and then laying them off when either the net or the weather is bad?

I won't try to answer these questions: I simply raise them for consideration.

But it does seem possible that the job preservation agreement of February 7 does not stem wholly and solely from the desire of the unions to preserve jobs so as to collect more dues—the sort of thing the Firemen's union is doing. The desire to collect dues was certainly a factor, but it seems to me the agreement results, in part at least, from genuine human need.

There were indications that an agreement like this might come. There was handwriting on the wall that the industry might have read, but didn't. One of the earliest signs was the Emergency Railroad Transportation Act of 1933, which for a time required a job freeze of all employees affected by consolidations. Then there were the Washington Agreement of 1936 and the Harrington amendment of 1940, both also relating to employee protection in consolidations.

There was the Maintenance of Way Section 6 notice of 1950, calling for stabilization of employment and a guaranteed annual wage. There was the somewhat similar demand of 1957.

There was, in fact, the gathering emphasis in our society on security—railroad retirement, social security, unemployment insurance, medicare, the guaranteed annual wage (now in effect in some industries), and S. U. B.—You name them.

The signs were there, but I'm afraid we disregarded them.

And now, look what we have: We have an agreement, a very complex, hard-to-understand agreement, that not only preserves the employee in his employment but also appears—at least to the unions—to preserve his job even when the employee leaves it. It not only provides for the employee now in service but, according to the unions, puts a cap on attrition and forces us to hire new employees even when we don't need them.

The pendulum has swung with a vengence. Not only is the employee protected—and there is some justification for this—but it appears the job is protected—at least the unions say it is—and there is no justification for this, at least none that I can see. Moreover, the unions say the agreement restricts us from making changes we have heretofore been free to make—changes in operation, changes in organization, changes in technology, in machines.

One of these days this agreement will be revised. When that day comes, I hope our negotiators will insist most strongly on eliminating any provision that prevents us from abolishing an unneeded job when the employee on it leaves the service. There is no excuse for such a restriction. And I hope our negotiators will insist most strongly also that, so long as we protect the employee, we must have in return complete, union-recognized freedom to make technological, organizational, and operational changes in order to operate at maximum efficiency. The pendulum must swing back.

So much for generalities.

As I turn now to the job you hired me to do today (I'm singing for my lunch), as I turn now to analyzing the agreement, I caution you once again that what I say is not authoritative, it is not binding on anyone; it is simply one person's view of what the February 7 agreement means.

Now, I lay stress on that point because I am not on the committee that is attempting to reconcile the agreement. Last week the committee met with the Brotherhood for the second time. The word I have is that not too much progress was made in attempting to reconcile the different points of view.

The most you can hope for from what I say today is that your attention will be focused for a time on an agreement you have already studied, perhaps over and over. But by taking the time to think about it yet again, you may, because of your own rethinking of the agreement rather than because of anything I say, come to a better understanding of it than before.

Here is my analysis.

The first two sections of the agreement establish two kinds of protected employee —the non-seasonal, or regular, employee and the seasonal, or irregular, employee.

The regular protected employee is a non-seasonal worker who meets these three requirements:

(1) He was in active service sometime —any time at all—between October 1 last year and February 7 this year, both dates inclusive;

(2) He had, as of last October 1, at least two years' employment relationship;

(3) He worked at least fifteen days in 1964.

If the non-seasonal, or regular, employee doesn't meet ALL THREE of these requirements, he is not a protected employee.

Note the words "active service" in item (1).

The regular protected employee must have been in active service between October 1 and February 7, and the agreement defines "active service." An employee in "active service" is an employee who sometime between October 1 and February 7 was:

(1) Holding an assignment; (2) transferring from one assignment to another; (3) on an extra list and working or available for and responsive to calls; OR (4) (if extra boards are not maintained) on furlough but responding to extra work when called, and averaged seven days' work a month in 1964 while on furlough.

Section 1 provides that such an employee on furlough February 7 was to be returned to "active service" before March 1 and to be retained in "compensated service" as provided later in the agreement.

I would construe our obligation not to mean that we must create unnecessary jobs for these men but that we must merely restore them to "active service" as defined and pay them compensation as required. Here, to repeat, is what "active service" means. An employee is in "active service" if he was doing any one of these things. Our obligation was to restore him to any one of these and is to pay him such compensation as Article IV of the agreement entitles him to.

So much for the regular, or non-seasonal, employee.

The agreement does not define a *seasonal* employee, but I should think typical seasonal employees might be bridgetenders, extra-gang laborers, ore-dock workers, and Christmas mail handlers.

A seasonal employee who worked in 1962, 1963, and 1964—in all three years—is to be offered employment in 1965 and each subsequent year at least equal to what he worked in 1964. For example, if he worked 90 days in 1962, 130 days in 1963, and 100 days in 1964, he is to be offered at least 100 days' work in 1965—the same as he worked in 1964—and 100 days' work in each subsequent year.

The agreement doesn't say so in so many words, but we on the IC construe the seasonal provision to mean that the employment relationship must be continuous, just as in the case of the regular, or nonseasonal, employee. It doesn't make sense to have a greater obligation to a part-time worker than to a full-time worker.

Your first job under the agreement was (I say *was* because I assume you already have done it) to determine who was a protected employee and whether he was a protected regular employee or a protected seasonal employee. Each railroad devised its own method for making these determinations. I had intended to tell you how the Illinois Central made the determinations, but time won't permit.

The next section—Section 3—deals with business declines. In the event gross operating revenues and net revenue ton miles for a 30-day period decline more than 5 per cent as compared with the average for the same period in 1963 and 1964, the company may reduce the number of protected employees 1 per cent for each 1 per cent decline in excess of 5 per cent.

This calls, as I read it, for a prediction by the company of how business is going to be. This is largely up to the Traffic department—at any rate, up to headquarters. Your job is, after your company makes the prediction, to determine, with such direction as you may receive, whether to make the permitted force reduction and to issue notices of force reduction as required by the schedule. Of course, if your Traffic department guesses wrong, estimating an 8 per cent reduction that turns out to be only 4, you will have the mopping up job, the job of undoing what you have done.

When business is restored, you have 15 days to recall protected employees.

The fourth section of Article I deals with emergencies. Section 4 is a provision that permits a company to reduce forces temporarily on account of such emergencies as fire, flood, snowstorm, hurricane, earthquake, or strike. But you may reduce forces only if their work no longer exists or cannot be performed, and you must give 16 hours' advance notice of reductions. When the emergency is over and operations are restored, you must call the protected employees back.

The section about business declines, incidentally, applies company-wide whereas the section on emergencies applies locally but may also apply company-wide. You may have a business decline of 10 per cent on your division, but you still won't be able to use the business-decline provision unless your company as a whole has suffered at least a 6 per cent falling off. On the other hand, you may use the emergency provision for either a local emergency or a company-wide emergency.

Section 5 of Article I, the cap or lid on attrition, is one of the more controversial provisions of the agreement, and the railroads and the five unions are widely apart in their interpretation of it.

Section 5 provides that the company must "maintain work forces of *protected* employees . . . in such manner that force reductions of protected employees (as defined in Section 1) . . . shall not exceed 6 per cent per annum."

But what if you have a total of 100 protected employees and ten of them, or 10 per cent, quit or die in a single year? How in the world are you going to keep from exceeding a reduction of six protected employees, or 6 per cent, that year?

The unions say you've got in this situation to recall from furlough four non-protected employees or, if you have no furloughed non-protected employees, hire four new men. But you still wouldn't be complying with the agreement if you did this, for the agreement says you've got to maintain your forces of *protected* employees at a certain level; and there isn't any way under the agreement to convert either a non-protected employee or a non-employee into a protected employee.

I haven't heard a single one of our negotiations agree with the unions' transposition. Those whom I've heard speak on the subject say the unions' interpretation is wrong.

One labor relations officer (and he was not one of the negotiators) has pointed out that the term *force reduction* as used elsewhere in the agreement—for example, in Sections 3 and 4—means *furlough;* and he reads the provision on the screen to mean that the company may not furlough more than 6 per cent of protected employees a year. If this is the correct interpretation, the provision is not bad. Another, striking a compromise, suggests the provision means that, in the example I used, we would have to recall four furloughed non-protected employees if we have them but would not have to hire new employees; but I don't follow his reasoning. Other personnel men have advanced other interpretations in an effort to make sense of the provision; but, to me, the provision is nonsensical.

Inevitably, Section 5 is going to have to be interpreted by the disputes committee established by another provision of the agreement, and unless and until the disputes committee says we've got to hire new employees to keep employment from decreasing more than 6 per cent a year, I certainly would not advocate hiring them unless you actually need them. Neither would I treat a new employee or any other non-protected employee as a protected employee.

The railroad unions have done and are doing a lot of good. I wouldn't have us without them if I could. But it seems inexcusable to me for a union to try to force a company to hire unneeded employees simply to perpetuate the union or to bring in union dues. We should no more hire maintenance-of-way employees or clerks for this purpose than we should hire locomotive firemen to keep alive the Firemen's union.

Article II deals with the use of protected employees and loss of protection. It clarifies that a protected employee entitled to compensation may be used in accordance with the seniority rules for temporary assignments, such as vacation, holiday, or sick relief, but says that he must be paid traveling expenses in accordance with existing rules or, if there is no such rule, under a rule to be negotiated. That is one of the troublesome things about the agreement. A good many railroads are facing negotiations about traveling expense rules, and I don't believe much progress has been made there. It certainly has not been made on the Illinois Central.

It says also that an employee loses his protected status if he resigns, dies, retires, is dismissed for cause, fails to retain or obtain a position available in the exercise of seniority, fails while furloughed to accept extra work, or fails to accept employment in his craft in accordance with local implementing agreements made under the February 7 national agreement.

You will want to pay particular attention to refusals or failures to accept work; for, if an employee wilfully forfeits his protection by not working, there certainly is no good reason to continue to protect him.

Article III recognizes management's right to make technological, operational, or organizational changes. It also concedes to management the right to transfer work, employees, or both throughout a railroad system, irrespective of seniority districts, provided the transfer does not entail crossing craft lines, and it requires the unions to enter into implementing agreements with management or allocating and rearranging forces in cases where, under preexisting rules, transfer of forces was prohibited.

Recognition by the unions of management's right to make changes and that according to management the right to transfer work or employees or both across seniority district lines were the only good things about the agreement, from management's standpoint, that most of us could see when we first read it.

This is the one provision of the agreement, we all thought, that is for the benefit of management rather than for the benefit of the employees or for the benefit of the unions.

Not so, according to the unions. Article 3, the unions say, places restrictions on management where restrictions formerly did not exist. Here is a quote from one union:

> "It is the position of our Brotherhood that any and all technological, operational or organizational change(s) requires an implementing agreement, even

> if such change(s) merely involves the merging of two positions into one within the same seniority roster in the same seniority district."

Quoting again,

> ". . . the February 7, 1965 Agreement now grants the Organizations a voice in determining whether or not forces are adequate to meet a carrier's requirements . . ."

As I understand the union's position, almost any change at all that you want to make—abolishment of a job, addition of a job, introduction of a new machine, change in the territory of a section gang or a B&B gang, or what have you—all of these changes, according to the unions, require an implementing agreement with the union, and you must go through time-consuming negotiations and possibly even arbitration before you can make them.

This union position, in my opinion, is nonsense.

Regardless of what the unions say, I can see nothing in Article 3 that in any way restricts a company from making changes it was free to make prior to February 7, and I can see nothing in Article 3 that requires a company to make an implementing agreement with regard to such a change.

To me, Article 3 means simply that the unions pledge to quit fighting technological, organizational, or operational change. It means that, in consideration of the generous employee protective features, the unions concede to management the right to transfer work, employees, or both, anywhere on the system without regard to seniority districts; and that they agree to make implementing agreements with management, where necessary, for the reallocation and rearrangement of forces in order to make the changes effective. I predict the unions are going to give up on this foolish position they have taken. They have not given up yet, but there are indications they are weakening.

Under Article 3, *where the change is of a nature as to require an implementing agreement,* you must give a 90, 60, or 30-day notice. You must give 90 days' notice of a change requiring a change in residence (as from Seniority District A in Chicago to Seniority District Z in Los Angeles), a 60-day notice if no change in residence is required but more than five employees change seniority districts, and a 30-day notice if there is no change in residence and no more than five employees must change seniority districts. Article III describes what the notice should contain.

If the parties make no implementing agreement within a certain time—30 or 60 days—either party may refer it to a disputes committee established by Article 7, and the disputes committee has to make a decision expeditiously—normally within a month.

Article IV describes the compensation due protected employees. It establishes two different formulae—I said that to show I remember my high school Latin—two different formulae—one for employees who held regularly assigned positions last October I, and the second for all other protected employees. Note that the division in Article IV differs from that in Article I. In Article I, the division is non-seasonal (or regular) versus seasonal (or irregular), whereas, in Article IV, the division is assigned and not assigned.

In the one case—that of employees who held assignments October 1—compensation is based on the rate the employee was making that day. In the other—unassigned employees—it is based on a formula similar to that of the Washington Agreement—average monthly earnings in the last 12 months in which the employee performed compensated service—but the guarantee is adjusted to include subsequent general increases.

It is essential that you know what monthly compensation is due each employee of the second group (the employees who did not hold assignments last October 1) for the amount of compensation due him may have a bearing on how much you work him. If you owe him the equivalent of 10 days' pay a month, you may want to work him at least 10 days a month in order to get work for the time you pay him for.

One point that deserves mention is that protected employees are not entitled to benefits when furloughed on account of seasonal requirements—including miners' holiday and Christmas—provided the furlough does not last longer than it did last year.

Article V deals with two disparate subjects—moving expenses and separation allowance.

Any protected employee required to move his residence *in accordance with an implementing agreement* is entitled to five days for moving, to a $400 transfer allowance, and to moving expenses and loss, if any, on his residence as provided in the Washington Agreement. Note that I said "required to move his residence *in accordance with an implementing agreement.*" A move resulting from present rules rather than from an implementing agreement is not covered by this provision.

That is one of the big issues between the unions and the railroads at the present time. The unions are trying to take the position that this provision refers to a move at any time, whereas the language of the provision I think supports the position of the railroads, which is that this provision applies only to a move made in accordance with an implementing agreement.

If the employee has 15 years' service, he may resign instead of moving and take a separation allowance of 360 days' pay at the rate of the last position he occupied. Keep this in mind when planning moves: With a payment of 360 days at a rate of $20, it could cost you $7,200 per man to make the move.

Time is getting short, and I shall pass over without comment remaining provisions respecting mergers, the disputes committee, term of agreement, and court approval except to remind you that this agreement by its terms remains in effect at least until June 30, 1967. You are saddled with it until then. Whether or not the more onerous provisions can be modified at that time depends on how much you and your personnel people holler and the determination of your national negotiators.

My own opinion is that, if the agreement were rewritten so that we could understand it, if the cap on attrition—whatever it means—were removed, and if the unions will give up their abused position that you can't make changes in methods, manning, or machines without their approval or arbitration—my opinion is that, if these three things happen, this is an agreement you can live with and perhaps even profit by.

A fellow personnel officer made a remark to me some weeks ago that has changed considerably my attitude toward the February 7 agreement. He heads the personnel department of one of the larger railroads. He said in substance that, if Article III is interpreted to mean what he understands it to mean—that is, that it doesn't restrict or impair management's pre-existing right to make changes but that it provides a means of making changes that management formerly was restricted from making—he said that if Article III adds to but does not restrict management's rights, the agreement will benefit rather than hurt his railroad. He said that there are any number of changes—some large, some small—that his railroad had been wanting to make but couldn't because of agreement restrictions and that Article III now provides a way to make them. He agreed with me in principle that it is totally wrong to have a cap on attrition but said that, in practice, his road won't be much hurt. And he added that, on balance, his company will gain more from Article III than it will lose because of other provisions—that is, if Article III is interpreted correctly.

Types of changes possible? Well, here are some we have in the mill on the IC: transferring section laborers in some instances to division extra gangs; moving excess painters in Louisiana to Chicago; putting certain B&B helpers on a system bridge gang; establishing clerical jobs that serve more than one department. And this barely skims the surface. I heard week before last that one railroad has served on the maintenance of way union alone 119 notices for changes it formerly could not have made.

Perhaps we all ought to look at the bright side: we ought to think positively rather than negatively about the February 7 agreement. We have it, and it doesn't do any good to bellyache about it, however badly some of us may have been hurt—and some were hurt. Instead, let's consider, not what we can't do under the agreement that we could do before, but instead what we can do now that we could *not* do before. Let's look for the gold in the agreement. Let's spend our energies thinking up possibilities, now opened up, for greater efficiency, and let's do everything we can to make those possibilities realities.

Maintenance-of-Way Training on the Canadian National Railways

Altan V. Johnston
Chief Engineer
Canadian National

During the past 10 to 12 years there has been a tremendous increase in, and emphasis on, training throughout all departments and sections of CN. These range from our annual staff training course, which runs for six weeks each summer, for a class of 50 senior and middle management officers and personnel, to training courses of various lengths for new as well as older employees in virtually all departments. Briefly some of the details of the training programs are as follows:

Signal Training

This program provides for the training of a group of schedule employees under an agreement with the Brotherhood of Railroad Signalmen. Four hundred Signal apprentices receive six days of classroom training per year in two three-day sessions. These apprentices are scattered all across the Canadian National System in Canada and they are brought together in groups of four to eight in selected locations, and trained in a signal instruction car equipped with the latest in signal apparatus. Between visits of the instruction car to those locations, training material and home study assignments are sent to the students. The program lasts four years and each successful apprentice must pass a total of eight examinations covering both written and oral tests. The same training course is also given to signal maintainers and mechanics on a voluntary basis, if they want to take it, and about 200 of them have elected to do so, increasing the total number of signal employees who are taking the training course to about 600.

Work Study

Seminars of three to five weeks intensive instruction are being given each year to selected employees. When I speak of work study, perhaps it is more familiar to you as industrial engineering. We have attempted to keep it away from the connotation of engineering, but the terms are synonymous. They are trained in the basic concepts of work study, or industrial engineering as you may call it, and become work study analysts. More sophisticated seminars in production planning and control are given to selected groups who are already thoroughly familiar with the fundamentals of the basic and intermediate work study courses.

Critical-Path Method

Our Research & Development Department has a small well-qualified group who give instruction and training in the critical-path method. This year 100 people will be given a five-day course in the fundamentals, as well as the advanced techniques of this very useful planning method.

In addition to the above specific programs, training is being given to employees, supervisors and managers of passenger and freight sales and service, to freight handlers in loss and damage prevention, through proper blocking and protection of shipments, and of course the usual and long-standing apprenticeship training for machinists, mechanics and electricians. Management development courses are being given to an increasing number of supervisors, and in this context the Blake course, often referred to as the managerial grid system, developed by Dr. Blake of the University of Texas, is being used extensively. Instruction in both the French and English languages is being given in the Province of Quebec, to employees who are deficient in this respect.

However, knowing where your interests lie, I want to deal more specifically with maintenance-of-way training which has not been mentioned as yet.

The basic idea of training maintenance-of-way personnel was one of the concepts of the Labour-Management Co-operative Committee Movement which was agreed to between management and labour and became effective on CN in January, 1930. In December, 1929, at a division co-operative meeting in Edmonton, Alberta, it was suggested that systematic training should be organized to its sectionmen for promotion to section foremen. A Labor-Management Sub-Committee was formed and a plan was developed to start the training plan in the fall of 1930, under the direction of the Chairman of the Edmonton Division Co-operative Committee. So far as I can determine this is the first formal maintenance-of-way training program on CN. But within a relatively short period, the full effect of the depression made it necessary to discontinue this program.

You may be interested in some of the ground rules which were established at that time. One candidate for training was selected from each roadmaster's territory, who was either an assistant foreman, relieving foreman, or a good candidate for these positions, and one foreman on each roadmaster's territory was appointed to be a training foreman. Training locations were chosen to provide a wide range of conditions for the students. The course of training was a total of seven months each working season, not including time spent at extra-gang work. Whenever extra gangs were set up during the training period the candidates in training were transferred to these gangs, in a working capacity, for a definite period to broaden their experience. All candidates carried their original rate of pay with them to the extra gangs, except when they filled higher rated positions.

All candidates were to be chosen from applicants in good standing within the Brotherhood of Maintenance-of-Way Employees and who were satisfactory to the roadmaster and to local representatives of the Brotherhood., Other qualifications being equal, the senior applicant was given preference, but the ability to learn and perform the work effectively was to be given prime consideration. All candidates had to be under the age of 50 and able to read and write the English language. All received an examination at the end of each 30-day period and the failure to pass two examinations barred the applicant from further training. Training positions were not bulletined and the position made vacant at the trainees home station was filled temporarily. He was allowed eight hours each day while traveling and straight time at his regular rate for extra hours worked in extra gangs.

While maintenance-of-way training continued to be an item for spirited discussion at all Co-operative Committee meetings, no progress was made towards developing a formal training program until the System Labor Management Co-operative Committee Meeting held in September, 1953, where the subject was thoroughly discussed. Following this meeting, the former Western Region of CN was given authority to set up the initial maintenance-of-way training program as a co-operative venture with the Brotherhood of Maintenance-of-way Employees.

I would like to explain at the moment during the course of training our organization was changed on the Canadian National from three regions to five, and I will refer to the three orginal regions. Atlantic, Central and Western regions. Since 1961, we have added the Great Lakes region and the Mountain region. As I go along you will understand any reference to former and present regions.

By that time the depression years, World War II, and the post-war construction boom had all played a major role in depleting what had previously been a properly organized and efficient working force. Management and Brotherhood were equally concerned about this situation. Brotherhood officers in Western Canada did not like the prospect of an increasing amount of maintenance work being done by contract which had previously been done by a skilled reservoir of railway labor. Management on its part fully realized the advantages inherent in a well-organized and efficiently-trained Maintenance-of-way Department. But prior to a start on actual training, it was necessary as a first step to appoint a training supervisor, to determine actual training needs, and prepare necessary curricula. A great deal of care had to be exercised at this stage, particularly in determining the extent and details of the training needs. It was established that the most urgent immediate need for training lay in the B&B Department, and it was decided to start with training of B&B foremen and relieving foremen.

Committees, consisting of the division engineer, or his representative, the B&B master, the training supervisor, and the local chairman of the Brotherhood of Maintenance-of-way Employees were established at each division point across Western Canada. This Committee compared each B&B foreman or relieving foreman, on the division with an imaginary prototype foreman having all the qualifications required for the types of work to be done on that division. It was a time-consuming and rather difficult task, but out of this survey came the specifications for training needs of B&B foremen across the Western Region.

A Planning Committee, under the Chairmanship of the training supervisor, and including the regional engineer, a line B&B master, a terminal B&B master, the engineer maintenance-of-way, the bridge engineer, the building engineer, and the general chairman of the Brotherhood along with other Brotherhood representatives, then mapped out a training program which would satisfy the more urgent needs indicated by the survey. At that meeting a small committee, consisting of the engineer maintenance-of-way, the asst. general chairman of the Brotherhood, and the training supervisor, were appointed to prepare the training curricula. When this was completed, it was approved by management and by the planning committee.

The initial group of eight B&B foremen attended the first training class for such individuals on the system in Winnipeg during the period of May 2 to May 30, 1955. At that time sixteen categories of instruction were given as follows:

(1) Job Relations
(2) Job Instruction
(3) Care of Electrical Machinery
(4) Concrete Work
(5) Fire Prevention
(6) Job Safety
(7) Explosives
(8) Blue Print Reading
(9) Timber Framing
(10) Tackle and Rigging
(11) Rope Splices
(12) Care of Internal Combustion Engines
(13) B&B Paperwork and Reports
(14) Job Planning and AFE Accounting
(15) Saw Sharpening
(16) Principles of First Aid

Instructors in all these subjects were obtained from railway personnel with the exception of information on the use and fusing of explosives. Instruction on this subject was given by a qualified engineer, from one of the explosive manufacturing companies, over a period of one day.

Training continued along these lines, for B&B foremen only, until 1958 when a pilot course was prepared and presented to a group of work equipment operators.

This course lasted two weeks, and covered the general care, operation and maintenance of such machines as power wrenches, spike hammers, spike pullers, adzing machines, power jacks, track liners, ballast regulators, and tampers.

In the fall of 1958, the training course for B&B foremen at Winnipeg, was expanded to cover a full five-week period of 25 working days. This allowed for some extra training time in concrete work, framing of doors and windows, first aid, and the use and care of power tools.

The work equipment operators course was split into two main types, as follows:

a) Those operators who would be assigned to rail-relay gangs were taught to operate and service power wrenches, spike pullers, spike hammers, adzers, rail layers and gaging machines.

b) Operators to be assigned to ballasting gangs were taught how to handle and service power jacks, track liners, ballast distributors and tampers.

In early 1959 the former Central Region and the Atlantic Region appointed experienced graduate professional engineers as training supervisors, who undertook the necessary preparatory work to determine training needs on their respective regions. The survey and the analysis, together with the training of instructors, consumed all of 1959, and training commenced on both Regions early in 1960.

On the Atlantic Region roadmasters, asst. roadmasters, work equipment supervisors, and section foremen were given a total of 186 man-weeks of training. On the former Central Region, roadmasters, asst. roadmasters, work equipment supervisors, and asst. supervisors, work equipment shop foremen and asst. shop foremen, district signal supervisors and inspectors, division supervision, work equipment operators, track welders, B&B foremen, and section foremen were given training which totaled up to 627 man-weeks.

On the former Western Region the extent of training was much the same, but a more comprehensive welding training program was given to maintenance-of-way personnel. Although the training program in rail welding was by far the most extensive, training in four-position welding was provided to shop mechanics, field maintainers of work equipment, B&B personnel and Regional steel bridge men.

During the year 1960, 1,100 man-weeks of training were provided on the system, of which 406 man-weeks were on the former Western Region. During the 1960–61 training season (October 1–April 1) a new additional course was introduced on the Prairie Region to train and upgrade the skills of B&B carpenters. This course was originally scheduled for two weeks, but the time proved to be so limited even with voluntary attendance at several evening courses, it was extended to three weeks during the following training season of 1961–62.

During the 1961–62 training season a further renovation of maintenance-of-way training was the provision of work study training to selected nonscheduled maintenance-of-way candidates. The initial course covered a period of five weeks, including intensive evening work.

In 1961 our company was re-organized from three to five Regions in Canada, and maintenance-of-way training has become an integral part of the activities on each of these Regions. Since 1961 the man-weeks of training have been in excess of 1,400 annually, and during the 1964–65 training season, amounted to 1,588.

We are fully committed to a continuation of this program, as we believe that properly trained, competent maintenance-of-way forces are essential to obtain the best results from rapidly increasing mechanization and automation taking place within the industry.

In the brief time available I have attempted to give you a summary of the organization and development of our maintenance-of-way training program over a period of ten years. However, this afternoon Mr. C. E. Wachter, chairman of Committee No. 1, is going to present a report on training in general as it affects all railroads. I have given you some of the details of what we are doing on the Canadian National. Mr. Wachter will outline some of the problems and things that can be done by railroads on a broader scale.

In closing I would like to make reference to the part the Brotherhood of Maintenance-of-way Employees, officers as well as men, has played in helping to make these training programs work. The Brotherhood has supported training in every respect, and it has even joined with railway management to furnish financial aid to those of its members who have voluntarily undertaken outside courses. Fifty percent of the cost is remitted to all candidates who successfully complete home study courses, such as those which are available for B&B foremen and section foremen, and the cost of this program is being shared equally by railroad management and the Brotherhood.

The film which you are now about to see was made originally for training of classes in work study (industrial engineering). However, it proved to have considerable value as part of the course for track maintenance forces, from roadmasters down, and is now being used regularly for that purpose.

To complete my presentation I have a film to show you now which was made originally from the training of classes in work study, as I mentioned, industrial engineering. When we had the film finished we found it was of so much interest it is being used now as part of the regular training course for maintenance forces, particularly supervisors. I hope you will enjoy this film. It is not perfect, we know. It was designed for a particular purpose. There may be some things that you could do better and we readily admit it.

Timber Trestle Maintenance, Procedures and Equipment

Report of Committee

COMMITTEE—V. D. Raessler, *chairman,* supvr. b. & b. & w. s., IC, Memphis, Tenn.; D. O. Bichkam, *Vice Chairman,* mast. carp., CB&Q, McCook, Neb.; D. D. Boatright, *Vice Chairman,* dist. rr. mgr., CHIPMAN CHEMICAL CO., Bessemer, Ala.; L. K. Arnold, asst. gen. fore. b. & b. & w. s., AT&SF, San Bernardino, Calif.; G. W. Benson (ret.), div. engr., C OF G, Macon, Ga., S. A. Cooper, chf. engr., GM&O, Mobile, Ala.; E. W. Cox, mgr. ry. sales, W. T. Cox Co., Camdenton, Mo.; J. W. DeValle, chf. engr., brdgs. & struct., SOU., Atlanta, Ga.; C. L. Goodman, asst. supvr. b. &b., C&O, engr., brdgs. & struc., SOU., Atlanta, Ga.; C. L. Goodman, asst. supvr. b. & b., C&O, brdg. insp., SAL, Savannah, Ga.; S. Makarowski, asst. b. & b. mast., CN, Edmonton, Alta.; R. G. Simmons, gen. rdm., CMStP&P, Chicago; L. W. Simpson, mast. carp., B&O, Pittsburgh, Pa.; J. W. Storer, vice pres., Railroad Div., OSMOSE WOOD PRESERVING CO., Madison, Wis.; G. R. Vanderpool, brdg. engr., AT&SF, Amarillo, Tex.; H. Veldheer, asst. supvr. b. & b. & w. s., C&O, Grand Rapids, Mich.; J. M. Williams, mas. inspc., IC, Chicago.

Timber trestle maintenance, procedures and equipment present a constant changing challenge to the railroads of today. It is estimated that we have approximately 2300 track-miles of timber trestles on Class I railroads in the United States today and because of changing load and speed conditions, our bridge engineers have an ever-changing problem. The procedures and methods continue to become more technical and the equipment more efficient in doing the job.

Tools and equipment

The maintenance equipment used by most railroads has not changed to any great extent over the last few years. The equipment most generally used is the truck-mounted tower equipped with paint units, power staging, truck cranes which are capable of operating on or off track, with sufficient capacities and space to handle various materials, along with numerous pneumatic, hydraulic and electrically operated hand tools which are commonly used by maintenance gangs.

One railroad reports they have devised some special tools for trestle work including guides for chain saws for use in cutting off piles accurately, steel hangers which hook over bent caps and support scaffold needle beams, a device consisting of threaded rods with crank ends for lining up piles of bents prior to cutting off

V. D. Raessler
Chairman

and capping, a device for accurately adjusting the spacing from bent cap to bent cap when installing stringers.

Most railroads commented favorably on the usefulness of the power operated derrick with the 13-ft boom.

One company now has on the market an 8,500 lb capacity crane and power boom that can be mounted on a truck carrier of 27,000 lb G. V. W. and up and is hydraulically operated. It handles scaffolds below deck level with great precision, puts men in position to inspect, repair, sand blast, strip forms, and do other tasks with greater speed, efficiency and safety, while at the same time reducing overall labor costs.

Work methods and procedure

New ways and methods to do the various jobs are discussed herewith:

One relatively new method is the procedure of tie renewal on steel spans of such heights and length to justify ties to be replaced in panels. The general practice is to pre-assemble 39-ft panels and stock pile them adjacent to the bridge ends, the panels to be complete with ties, plates, pads, spikes, rail and guide rail in place. First, even joint the rail on the bridge and cut the guard rails opposite the joints, then using a pile-driver derrick with a special panel lifter, lift the old deck panel out and carry it to the bridge end. A new panel is placed in the vacated spot, one rail length at a time. On one particular bridge 1230 ft long, 186 ft high, the 31 panels were replaced in six days. It was estimated it would have taken six weeks under the old method of manually replacing the ties. Also, the safety of this work method should be given consideration. Needless to say, the above procedure cannot be followed for ribbonrail.

Timber bridge maintenance due to excessive wheel load weights, train speeds, and the greater frequency of such loads handled, is now becoming an alarming problem. These factors produce mechanical wear in timber, crushing in caps, and pumping in piling. The problems created here require that inspection methods be changed likewise. However, the inspection methods of some roads have not been changed in this period. The trend is for those roads handling the heaviest loads to make timber trestle inspections more intensive and more frequently. Inspections are made visually and by sounding and increment boring. One railroad uses a nuclear ray instrument in inspection of timber trestle members.

The greatest change in inspections is in intensity and frequency. These inspections range from continual to semi-annual. The number of persons making timber bridge inspections has not increased in the last ten years except in a few instances. Inspections should be made of caps, stringers, piling, posts, sills, and ties in this order of importance, and reports made to the proper authorities if undesirable conditions are found.

Experienced judgment remains the most widely used criterion for evaluating timber conditions and the need for replacement. Other criteria used are fixed limits, age of trestle and excessive maintenance.

One of the most promising devices used to protect caps from piling is a rectangular steel plate, slotted to accommodate the drift bolt with a raised indented lug to keep the plate in place, which is placed between the pile and the cap. This plate distributes the load over a greater area of the cap so that compressive stresses perpendicular to the grain in the cap closely approximate those parallel to the grain in the pile. Timber scabs may be bolted to both sides of the cap to provide additional bearing area for the stringers, which will help to combat crushing of both caps and stringers. Tighter bolt connections and more secure anchorage of timbers will reduce crushing as well as mechanical wear in bridge timber. Most roads believe that larger tie plates and tie pads are of benefit in reducing wear on ties and that this additional cost is justified. The heavy load frequency has had no noticeable effect on bracing of bents transversely or longitudinally.

Our problems regarding increasingly heavy wheel loads have yet to be solved and is a subject that will require study over a period of several years. New problems will arise and new methods will be employed.

We now have another problem to combat and that is timber maintenance and renewals of structures within the limits where continuous rail has been laid.

Some proposed rules

On one railroad consideration is being given to a proposed set of rules to be issued to all bridge and building foremen as follows:

(1) Before working on bridges where continuous welded rail has been laid, the laying temperature of the continuous welded rail must be ascertained.

(2) If the temperature of the rail at the time the work is being performed is below the laying temperature, the rail will be in tension. When rail is in tension on tangent track, no difficulty should be experienced. When in tension

the continuous welded rail, if not properly anchored and drifted, may pull to the inside of curves. If this occurs, at the first opportunity when the rail temperature approaches the laying temperature, the track must be restored to the original line. The ideal time to perform bridge work on bridges where continuous welded rail has been laid is while rail is in tension.

(3) If the temperature of he rail at the time the work is being performed is above the laying temperature, the rail will be in compression. When in compression, the continuous welded rail will tend to buckle.

(4) When working on ballast-deck bridges and the rail is in compression not over one panel of bridge may be opened up at one time. The converted portion must have every third tie drifted to the stringer.

(5) Stringers and caps on open-deck bridges cannot be renewed unless it is certain the job can be completed while the continuous-welded rail is in tension.

(6) When renewing ties on open deck bridges where continuous welded rail is laid and when the rail is in compression, no more than three ties should be removed at one time.

Developments in fastenings and hardware

It is generally agreed that timber connectors used in connection with a self locking nut and adequate bolt size have been most effective. New type spring washers, various styles of lock nuts and a much improved anchor or hook bolt for timber decks on steel bridges, are now commonly used with satisfying results. Some railroads have gone to the use of a drive spike in fastening an undapped smaller timber guard rail to the ties in lien of the bolts with dapped guard rail on open-deck type trestles.

Fire prevention on grounds

On one railroad it was reported in 1964 there was no significant damage to bridges due to grass fires. This certainly justifies expenditures in soil sterilants and other weed-killing chemicals.

Another road reports that there are many chemical combinations that can be applied safely that will keep the ground free of weeds and brush. To control deep rooted weeds and grasses, such as Johnson, Bermuda and sage, the best proven chemical combination is a dry granular chlorate combined with a safe fire retardant formulated with highly insoluble products applied at rates from 200 lb to 800 lb per acre. Rates of applications will vary on different railroads. To control annual weeds and grasses, certain highly insoluble products can be mixed with water and sprayed because they create no fire hazard if sprayed on any part of a wooden structure. However, chlorate should never be sprayed as a liquid around bridges and trestles because it is almost impossible to apply chlorate liquid solution without some being absorbed in the wooden structure. This will cause a fire hazard after the liquid has dried.

To control brush, vines, brambles, and other woody plants around bridges and trestles, the best proven chemical without any fire hazard is ammate, 2-4-D, and 2-4-5-T combinations mixed and applied at recommended rates.

There is no substitute for bare ground around bridges and trestles. You can't argue with weeds as they create a fire hazard as long as they exist.

It is the general consensus that the water barrel on bridges as a means of fighting fires is no longer effective or dependable.

One railroad reports that fireproofing of timber trestles should be used at those locations where the danger of fire is unusually high. This includes trestles at or near the bottom of long grades, or at other locations where heavy braking is required and hot brake-shoe material often drops from trains. At such locations, they have applied an asphaltic cement covered by stone chips to the top surfaces of open-deck ties and stringers.

In the reconstruction of long trestles, one railroad tries to place earth fire breaks so as to limit the length of any one section of trestle to about 20 panels. This also has the advantage of helping to prevent the longitudinal movement of the structure. They also state they do not attempt to maintain fire protective equipment on their timber trestles.

Use of preframed and bored replacement parts

Use of preframed and bored replacement parts by one railroad is as follows:

"In the construction of all of our new trestles, both on tangent and curves, we use preframed and bored caps, stringers, guard timbers and backwalls. The layout of these bridges is carefully done so that the various parts will fit properly, and we believe that this procedure reduces the cost of construction as well as lengthening the life of the structure.

"On maintenance we do not ordinarily attempt to use preframed replacement parts as our older bridges were built to various standards, and even within these standards the accuracy of construction was generally not such as would make the use of preframed parts practical. When the replacement of parts of our more recently constructed standard preframed bridges becomes necessary, we will no doubt be able to make increasing use of preframed replacement parts."

Another railroad reports that this practice should be used to maximum extent practical naming the advantages as: reducing field fabrication, permitting pressure treatment, and affording more rapid field assembly. The disadvantages may result in delay of delivery of materials and in some waste if not designed accurately.

In-place treatment and restoration

It is the general opinion of this committee that in-place treatment may be a good practice if applied to structures having sufficient remaining life to justify this expense as economically feasible. There are varying opinions as to when the remaining life of the structure can be judged to justify this expense. We feel that structures built in the late 1930's and early 1940's are the prime subjects. However, in general, the condition of this age structure is such that it should be free of any sizeable maintenance expenditure for another fifteen or twenty years. With this phase to be considered, along with the general financial condition of most railroads at this time, the maintenance dollar is more likely to be spent elsewhere.

The treatment of ballast-deck structures is debatable as to what members justify treatment. Some feel that piles with a certain amount of heart or outside ring can be restored. One road has instigated a program for the internal treatment of piling only, and has indicated that for E-60 loading on a five pile bent in a 30-ft high open-deck trestle, a 6-in void in a 14-in pile will not overstress it. They believe that in-place treatment is economically justified since the increased bearing stress due to this loss of 18.2% of area is still within design limits for compression both parallel and perpendicular to the grain.

The report made by one railroad is as follows:

"Under the proper circumstances we would recommend in-place treatment by means of surface application and internal injection of preservative materials. Also, in some cases the ground-line treatment of piling is desirable.

"In-place treatment is particularly indicated for structures which were originally well built, and which are still basically sound but which show increasing deterioration due to the leaching of original preservatives or progression of decay into portions of the structure, such as pile centers, which originally did not receive very much preservative.

"We have, by contract, treated numbers of such bridges. The actual benefits derived will have to be developed from results obtained over a considerable number of years, and while we do not yet have such data, we believe that the savings in maintenance have, or will, at least equal the cost of the in-place treatment."

Another railroad reports:

"Two years ago we applied in-place treatment and restoration to two of our larger aging trestles. Before undertaking this work, it was assumed that the treatment would extend the life of the trestles an additional ten years, and then we weighed the treatment cost against maintenance and replacement costs for the same period of time, and decided to apply the in-place treatment as a matter of economics. With reference to one of the bridges in the Edmonton area, this is a 77-bent untreated frame-and-pile trestle, 72 ft high, built 1934, 1,080 ft long, including one 76-ft deck-plate girder span on timber piers and one 24-ft timber span over a roadway. The deterioration in this structure had progressed to the point where consideration was given to replacing it.

"As the replacement cost of this trestle would have been quite high, several schemes were studied and it was learned that the cost of in-place treatment would be about 10% of the cost of replacement in kind, which was the cheapest of all schemes. It was therefore apparent that economies could be achieved by applying in-place treatment, and it was felt so even if only five years additional life was added to this structure."

Before considering in-place treatment, it is imperative that a close inspection of the structure be made. If a large percentage of the members have decayed to a point where there is any doubt of their remaining strength, consideration should then be given to rebuilding. It should be understood that this treatment is not 100% effective, and that some decay would continue at points that were possibly considered unimportant at time of treatment. However, if the structure has been found to be in generally good condition, and some decay already started at critical points, we would then consider treatment, as this application would be concentrated on these areas and decay would be corrected to a good degree, and the life of the trestle thus prolonged.

If a certain small section of a pile is deteriorated, most generally at ground line, there is now a method used to cut and remove the deteriorated section or plug and to weld in place with epoxy a new timber pile section. This is done successfully. However, it is questionable if the expense justifies this cover replacing same member in the conventional manner with a leg. Possibly this expense would be justified in the higher bents.

It is the general consensus that the timber we receive now is inferior to that used in structures built three or four decades ago. This fact along with improved preservative chemicals and methods, and with the now unforeseeable potentiality of epoxies makes it difficult to hazard a guess as to possible limitations of the in-place treatment. We all agree there is a need that is increasing each year.

Possibilities of prestressed concrete components

In this report we would like to point out the potential economy in reference to certain prestressed components that may be used in line with timber trestle maintenance only, mainly caps, ties, backwalls and bulkheads. Also, there is some reported use of blacking and posts.

High-strength steel and high-strength concrete are used and we feel all qualifying characteristics have been proven to our satisfaction. The weight of a cap 15 in by 14 in by 13 ft is 2900 lb. You will note they can be handled with push-car type derricks commonly used on almost all bridge gangs. The price of the prestressed cap is now practically on a par with the timber cap. It is also pointed out that all these members can be reused over and over again. The elimination of the fire hazard and resistance to decay and abrasion, are also important factors.

As of March 1965, at one precasting corporation, one railroad had on order 500 concrete caps that are to be distributed over their system for use in repair work on timber bridges. There were several more railroads with orders of various smaller amounts.

All committee members reporting were unanimous in their opinion that more prestressed components should be used, and predicted an increase in the use of caps, trestle ties, stringers, backwalls, blocking and posts as we learn more about them as well as how and when to use them.

After all that has been said, the methods and procedures of timber bridge maintenance on our various railroads are, in general, very similar. We feel that in most every instance the immediate supervisor has the greatest influence on the work habits, safety record, and efficient work production of gangs assigned to his jurisdiction.

Advantages and Disadvantages of Prefabricated and Portable Buildings

Report of Committee

COMMITTEE—H. J. LIESER,* *Chairman,* supvr. b. & b., C&WI, Chicago; P. E. Duffy, *Vice Chairman,* supvr. b. & b., GN, Minneapolis, Minn.; C. W. BEAN, *Vice Chairman,* mgr. rr. sales, ARMCO STEEL CORP., Middletown, Ohio; J. H. ADAMS, JR., bldg. engr.– sys., C&O, Huntington, W. Va.; R. ARRINGTON, des., SP, Houston, Tex.; V. A. DAVIS, reg. engr.–rr., ARMCO STEEL CORP., Atlanta, Ga.; M. L. EILUND, asst. engr., WM, Hagerstown, Md.; J. S. ELLIS, supvr. b. & b. & w. s., C&O, Grand Rapids, Mich.; S. W. GEORGE, div. engr., WM, Cumberland, Md.; W. A. JOHNSON, reg. engr., ARMCO STEEL CORP., Lafayette, Calif.; W. W. MAINS, area. mgr., ARMCO STEEL CORP., Denver, Colo.; M. MARSHALL, struct. engr., IC, Chicago; L. A. PALAGI, engr. arch., CRI&P, Chicago; C. H. SINCLAIR, asst. supvr. b. & b., C&NW, Milwaukee, Wis.; T. S. WILLIAMS, engr. bldgs., SAL, Richmond, Va.

Before a meaningful report on various types of buildings can be presented, it is important that certain terms be defined. The purpose of explaining and defining is only to set a common understanding for those who read and use this report. Without this some confusion would exist as these terms have come to mean slightly different things to different people.

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* Mr. Lieser died on June 17, 1965, shortly after preparing the report of his committee.

A conventionally constructed building is a structure made by cutting and fitting most of the parts on the construction site. This involves a maximum of field labor which is not always performed under the best working conditions. The finished result depends mostly on the skill of the workmen in the field.

A prefabricated building is a structure made of individual parts and assembling of these parts in a plant. The work is performed under ideal working conditions which result in good quality at lower cost. The design of prefabricated buildings is limited since pre-assembled units are inflexible and restricted in size by shipping requirements.

A pre-engineered building is a structure constructed from individual parts mass-produced in a plant. Pre-engineered buildings are usually constructed of metal parts. Finished parts are assembled on the construction site with a minimum of field labor. Design possibilities are almost unlimited because individual parts can be used in many different ways. The routine engineering design work is done by the manufacturer, which allows the railway design engineer more time to be creative and to deal with special engineering problems.

A demountable building is a structure made up of individual components that can be taken apart and reassembled. Prefabricated and pre-engineered buildings can be classified as demountable. Demountable buildings are relocatable.

A portable building is a structure that can be moved intact from place to place. Conventional, prefabricated and pre-engineered buildings can be constructed so as to be portable.

Mobile buildings are structures on wheels.

Two other words that are used sometimes to describe buildings are permanent and temporary. These terms are used to describe the life of a building and its use. Obviously, the type and quality of material used will, to a large degree, determine the life span of a building. Any of the three basic methods of consrtuction described above can be used to construct a long-life, permanent building or short-life, temporary building.

Prefabricated building

Prefabricated buildings are available in wood, concrete and metal and can be obtained in a variety of sizes for railroad use. As the structure size increases the selection of types and sizes decreases.

Prefabricated buildings have generally been used on railroad for oil houses, signal relay houses, and a limited number of other small buildings.

Advantages of pre-fabricated buildings are uniform quality at a generally lower price and fast assembly in the field. Disadvantages are the limited sizes of such buildings and type of materials available.

Pre-engineered buildings

Pre-engineered building manufacturers offer lines of buildings featuring a wide choice of length, width and height. Design freedom is accomplished by standardizing the building parts rather than the entire structure. Using parts in multiples results in a wide flexibility and has made it possible to vary the dimensions and details to meet exact requirements.

Pre-engineered buildings are avaliable in concrete and metal, the latter being available in many more sizes and shapes.

The pre-engineered concrete building is used for oil houses, relay houses, transformer shelters and other small buildings. At present, they are limited in sizes, but advances are being made in the construction of the sections by the use of lightweight concrete which may increase their use in the future. The Portland Cement Association has established practices for manufacturers in this field and is constantly alert for improvement with concrete products, not only for railroads, but for the entire construction industry.

Is very flexible

The pre-engineered metal building can be used for practically any type railroad building. It is the most flexible. In some types of metal buildings rolled steel sections are used for columns, beams, trusses, purlins, girts, bracing and framework for windows, doors and other openings. The components are fastened together with bolts or such types of fasteners which are positive but may be easily removed for dismantling and re-erection, or to permit structural modifications. Welding techniques have brought about the rigid-frame design which make possible long spans with a neater appearance than the truss design. The wide choice of structural frames makes it possible to design for exact requirements. To the framing systems are fastened prefinished wall and roof panels. Canopies are easily constructed.

Another design eliminates the structural frame and uses a unique method of forming heavy gauge sheets to modular width. These sheets have a deep interlocked joint that combines both structural integrity and an attractive exterior surface in a single unit. The building is obtainable in the gable-type or lean-to type roof. The rigidity and weather tightness of the joint withstands expansion, contraction and slightly unequal settlements.

Metal buildings can be finished on the interior with any of the conventional finishing materials. The roofs may be ventilated to exhaust objectional fumes or heat.

Sometimes skylights are provided. They can be of the conventional type or simply translucent plastic panels fastened in a weathertight frame.

Low-maintenance surface

Factory finished exterior panels provide a tough, long-wearing, low-maintenance surface. Certain finishes do an excellent job of reflecting heat in the summer and holding heat in the winter. Metal buildings are usually insulated for economy in heating and cooling and comfort.

The fire-resistant qualities of metal buildings make them desirable at points where there are fire hazards, at remote points where there is inadequate fire protection, or for the storage of inflammable materials. Firewalls (walls having a fire rating) are special problems that can be handled by construction of masonry walls, or special fireproofing.

Except in the case of unusual requirements, it is possible to get a pre-engineered building for most railroad purposes. Buildings will generally conform to the requirements of the building codes of most municipalities. A few municipalities have unusual gauge requirements, but in most of the cases a well-engineered building meets the codes.

Design data and plan information are furnished by reputable manufacturers so that the strength of the parts, the strength of the whole structure, and the expected life of the building can be checked by an experienced designer. It cannot be overemphasized how important it is to work with manufacturers that are members of the Metal Buliding Manufacturers Association. A Design Practice Manual put out by this association sets up minimum standards that must be met, thus assuring a high standard of quality.

The simplicity of construction and lower construction cost are two features of metal pre-engineered buildings which make them attractive for railroad purposes. Where a conventional building will require skilled workers of several trades, such as carpenters, masons, etc., a metal building of the types mentioned can be set up complete and ready for service by a bridge and building force of average skill and ability. This versatility will enable smaller railroads, which do not have building construction gangs, to erect these buildings with regular maintenance forces. Erection can be done without any special tools or power equipment.

Like conventional construction, the cost of a metal pre-engineered building can vary over a wide range. The functional requirements, quality of materials used, appearance, etc., all determine at what price building can be constructed.

When comparing initial costs, metal construction is competitive with conventional construction. If a good quality metal structure is built the annual maintenance costs can be kept to a reasonable level.

Advantages

Some of the advantages of pre-engineered buildings are lighter foundations than conventional buildings, pre-designed structural systems, fast erection time and a fairly wide variety of sizes and materials available. The usual clean-up of waste and clutter after completion of construction is kept to a minimum. The buildings can be erected in most kinds of weather, which makes them particularly advantageous in regions having severe winters.

The metal portions of pre-engineered buildings are salvageable and can be moved from one location to another. Of course, foundations, water and sewer lines, and wiring cannot be salvaged. Certain types of lining and insulation can be salvaged, others cannot. Oftentimes it is cheaper to buy a new pre-engineered metal building rather than taking apart and re-erecting an existing building. Most pre-engineered buildings can be readily expanded.

Some of the disadvantages of metal pre-engineered buildings are their limited asthetic appearance, shorter life and fire rating that does not come up to the standards required for certain building codes and fire zones. Metal buildings can be easily dented, and are not suitable for freighthouses or warehouses unless special protection is provided so that materials and equipment do not come in contact with the light metal panels.

Portable buildings

There are no portable buildings suitable for railway purposes available from manufacturers. A number of railroads have designed and constructed small portable depots, signal houses and other small structures. They are generally constructed on a structural steel frame and set on concrete piers. Some have been constructed with a treated timber frame. Conventional, prefabricated and pre-engineered construction can be used.

Mobile buildings are available from a large number of manufacturers of house trailers. They can be designed to special railway requirements for use as depots, officers, locker rooms and other small buildings.

Advantages of portable and mobile buildings are low cost and ease in moving from one place to another. Disadvantages are the limit in size that can be transported, either on a railroad car or on the highway. The life of a mobile unit is not as long as other types of construction.

Steel Railway Bridges—Methods of Protection from Corrosion

Report of Committee

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W. L. Short
Chairman

All railroad bridges, regardless of the materials from which they may be constructed have a maximum life expectancy which should be attained. In the case of steel bridges, a positive, systematic course of planned maintenance is generally required to prevent the steel from becoming unduly ravaged by time and the elements.

Nature of corrosion

Unfortunately steel undergoes chemical reaction upon exposure to most atmospheres; electro-chemical reactions occur with nonmetallic elements forming corrosion products that are either oxides or salts. The character of these products, particularly their solubility in the surrounding medium, their physical properties, and their position in relation to the metallic surface have a considerable influence upon the course of subsequent corrosion. If the products formed are highly insoluble and deposited as an impervious film in intimate contact with the metal surface, the reaction may be greatly retarded or stopped. If the products are soluble and not preciptated in contact with the metal surface, the reaction or corrosion rate may be unaffected. And finally, if only part of the metallic surface is covered, the reaction may be accelerated and produce pitting.

Ferrous metals have been used for many centuries and deterioration, has always been a factor in their use; however, serious attention to the science of corrosion prevention is of recent origin. The cost of repair or replacement of corroded structures, together with the interference or shutdown of operations can involve heavy financial burden. Without application of modern corrosion-control technology many industrial operations would not be feasible. Use of cathodically protected pipe for nation-wide distribution of petroleum products and use of stainless steels in the synthesis of nitric acid are examples.

Corrosion can be prevented but a sober analysis of cost is generally required. Steels belonging to the stainless family and monel metal have very good strength and high corrosion resistance in even the most aggressive environments, but the extremely high cost prevents general use for railroad bridges. There may be cases, however, where low alloy steels containing lesser amounts of chromium and nickel may be economical. These low alloy steels have much greater corrosion resistance than mild steel because the oxides that form on the surface are more highly bonded and impervious to the passage of oxygen and moisture. Even the best of these materials are subject to localized attack if improperly used. It is certain that mild or copper bearing steels will continue to be the principal construction material for railroad bridges. In many cases much can be done to extend the useful life of these brildges by protecting them against corrosion.

Methods of corrosion control

All corrosion control methods are based upon prevention of chemical reactions that lead to destruction of the metal. Several means of attack are possible. The effect of the environment in which the structure is exposed may be altered through consideration in design. This applies not only to the structure but also to the rolling stock that uses it. Fast-moving trains carry large amounts of soil and other debris that abrade protective coatings and build up deposits on structural members. Spillage, such as brine drippings, leachings from coal cars, etc., are often involved. It may be economical through choice of materials and design to prevent structural steel from being exposed to severe contamination; also, to mitigate the effects of contaminants that do reach structural members. Exposure to spillage can be reduced by use of ballast-deck design. Mechanical refrigeration eliminate brine drippings. Oxides that form on structural steel can be made more protective through careful control of the copper, phosphorus and sulphur content of the steel. Every effort should be made to eliminate open joints, crevices and pockets where soil and other corrosion stimulators collect and to use structural shapes that drain readily and permit easy access for cleaning and painting.

The principal method of protecting structural steel against corrosion is by insurfacing or shielding the metal from the deteriorating elements of the environment. This is done through the use of protective coatings. Such coatings, at their best, only restrict or delay the corrosion processes but coating life can often be increased through careful selection of material and by application of other effective means to aid in our light against corrosion. All serious corrosion that occurs to steel bridges is electro-chemical in character and can be stopped by imposing an insulating barrier between the anode and cathode. Materials such as coal tar, rubber, vinyl, etc., have high electrical resistance and are very impermeable to moisture and other corrosion stimulators.

Another method of preventing corrosion is by addition of inhibitors to the corrosive medium or to the metallic surface. The real mechanism of inhibitors is complex and beyond the scope of this report; however, it is believed that a mono-layer of ions is formed over either the anode or the cathode, and in some cases over both. These ions stand guard over corrosion stimulators and prevent them from reacting with the metal. Inhibitors which suppress corrosion by coating the anode must be maintained at sufficient level to keep the film intact, or intense, rapid, acceleration of the corrosion process may occur at the anode. Cathodic types of inhibitors are less critical to use but may not be effective.

One of the most effective methods used to protect steel against corrosion is by sacrificial action of another metal such as zinc or aluminum. This is a form of cathodic protection that is applicable for atmospheric exposure. The less noble metal is applied as an overlay in electrical contact with the underlying steel. The overlay may also act as an effective barrier to moisture and other corrosion stimulators in addition to providing sacrificial action. Such coatings are applied to thin sheets and small shapes that can be handled in picking and plating tanks by a hot-dip process called galvanizing. Such coating can be applied to existing structures and to parts too large to be dipped by a hot spray process called metalizing.

A galvanized coating of zinc consisting of 2 oz per sq ft has a life expectancy of about 20 years when exposed to a normal, unpolluted rural atmosphere. The life expectancy drops off appreciably when exposed in an industrial atmosphere unless proptective top coats are used over the zinc. Corrosion of zinc may not be as severe in a marine atmosphere as that occurring in an industrial environment but here, too, protective top coats of paint are often used to extend the life of the zinc.

Coating durability

Paint intended for use on steel can be formulated to retard or prevent corrosion processes in several ways by adaptations of the processes previously discussed. The most successful coatings do not necessarily possess all of these properties but in most cases more than one is involved. Service life depends upon so many variables that it is impossible to place a series of coating materials in an exact order for durability. The most important factor for all is how well the material adheres or is bonded to the steel. It is believed that not less than 75% of a coating's durability is associated with the adequacy of surface preparation upon which bonding or adhesion is intimately related. The importance of adequate surface preparation must be understood.

Results based on many years of investigations with metal primers and other paints applied on mild steel show pickling or blast cleaning increases paint life many times over that obtained on rusted or weathered surfaces. The same paints last almost as well in normal atmospheric exposure when applied over intact mill scale and protected by suitable top coats but last only about one-third as long when inhibitors are omitted from the prime coat. Practical experience dictates that regardless of the surface preparation methods used, the end condition must be conducive to good adhesion. Residue of oil, grease, soil or other contaminants resulting from inadequate or careless solvent cleaning, inadequate filtering of compressed air, or adulterated abrasives cannot be tolerated. Excessive brushing may burnish mill scale to a point where paint cannot adhere. Power tools, such as rotary descalers and chipping hammers, may leave sharp ridges on the surface if carelessly used, and coarse abrasives leave sharp peaks which cannot be adequately coated. Pin points of rust soon appear and accelerate deterioration of the paint. Welding operations leave deposits of flux and other chemicals that interfere with adhesion. Human sweat leaves deposits of salt that stimulate corrosion and results in localized paint failure. Regardless of the cleaning methods used careful inspection is necessary to assure adequate control.

Closely associated with surface preparation are pretreatment processes that in some cases are necessary to assure good adhesion or may be used to reduce the possibility of paint failure. Wetting oil is sometimes used to advantage over cracked and broken mill scale or over weathered steel when it is not practicable to use blast cleaning. Cold and hot phosphate treatments are available for use on pickled and blast cleaned surfaces. Also, several types of wash primer pretreatments have been developed that improve adhesion and make possible application of some materials that would otherwise not be possible to use.

Second in importance in determining the durability of most coatings is application of the material. Since the most important function a coating can perform is to shield the underlying steel from the corrosive elements, it is obvious that a continuous film, free from defects and of adequate thickness is required. The method used to apply the material is therefore important. Many types of materials are used and generally more than one method can be used for each. Time does not permit a discussion of all the various kinds of equipment used. Workmen must understand the equipment they use and know what it is capable of doing. Variations in coating durability attributal to application are generally the results of negligent workmanship rather than the method used. There is no substitute for knowledge and skill.

Paint should be applied as soon as possible after surface preparation operations have been completed, certainly before any detrimental contamination or rustback occurs. Great care should be exercised to see that no detrimental contamination or corrosion stimulators remain and that the surface is in satisfactory condition to permit adhesion of the coating material to be applied. The same precautions should be taken for subsequent coats and if contamination occurs, the surface should again be cleaned by the use of the most appropriate method.

Painting should not be permitted when the relative humidity is above 85% or when the temperature is below 40 deg F. Application without adequate protection should not be made in the early morning when the steel is colder than the air, also if rain or freezing weather is imminent. The preceding costs of paint should be sufficiently dry before recoating. There is danger of some materials becoming so hard that a phenomena called crawling ensues. When crawling does occur the surface should be lightly abraded with steel wool or fine sandpaper ahead of paint application. In some cases rubbing the surface with rags wetted in solvent may suffice.

Protective metal coatings

Finally, coatings suitable to protect steel railroad bridges will be cosnidered. The first and most obvious requirement is that the material be compatible for the service, it should be capable of performing the expected service under all environmental conditions that actually exist. In some cases it may be desirable or economical to use a combination of coatings.

Hot dipped coatings of zinc, and other metals are used to protect track and deck fixtures, also roof and side sheets. Hot spray coatings of these sacrficial metals are used to protect floor systems of steel spans against spillage such as brine drippings. These metalized coatings perform well to protect contact surfaces of structural members upon which span ties or other members of the track structure may bear.

Wherever paints are used a selection must be made of primer, intermediate and top coat. The primer should be correctly pigmented to inhibit corrosion and have sufficient wetting ability to assure good adhesion depending upon the type of surface preparation to be provided. If the primer is used as a shop coat on new steel it should be capable of protecting the steel during the construction period and until the steel is ready for field coating. This requires a primer possessing superior weather resistance and only the highest quality of paint should be used. When the prime coat of paint is applied after erection primers with less weather resistance may be used. The second or intermediate coat of paint should possess some degree of rust inhibiting properties but it should also possess good weather resistance and be as impermeable as possible to passage of oxygen and moisture. Wetting characteristics of this coat are not as critical as for the primer, therefore faster drying materials can be used. The top coat of paint should possess superior weather resistance and good color retention, especially at locations where appearance is important. It should be inert to the atmosphere in which it is exposed. If the environment is strongly industrial, the drying oil or oleoresinous coatings may be completely unsatisfactory and synthetic coatings based upon epoxy, rubber or vinyl may be required. In some cases thick top coats of bitumen are satisfactory for this service.

Another group of coatings in which considerable interest has recently been renewed are the zinc-rich coatings. They are of two basic types; those having organic vehicles and those with inorganic binders. The organic type forms a film similar to other organic paints. Only zinc particles are used as pigment and the resin, upon hardening, hold these particles tightly together and to the underlying steel. The pigment vehicle ratio is critical, since the zinc particles must be present in such quantity as to be in electrical contact with each other and the steel substrate in order to give cathodic protection. If lesser amounts of zinc are used, so that the vehicle forms a coating of resin completely around the particles of zinc and insulates them, the coating will be merely zinc pigmented without the added sacrificial value.

Formation of the inorganic film is quite different. The inorganic portion or binder reacts chemically with the finely divided zinc pigment and the steel substrate to form a matrix. The reaction is with the outer surface of the zinc particles and the susbtrate. The matrix formed is conductive and permits sacrificial action of the zinc. Being inorganic, the matrix is not significantly affected by weathering or by bacterial and fungi activity. The film adheres well to steel because of the chemical bond but may lose this feature of adhesion when applied to certain alloys. These coatings are not recommended for continuous immersion in strong electrolytes and the zinc is sensitive to either strong acids or alkali. Inorganic coatings now available will not tolerate organic contaminants on the base metal, thus demanding a high degree of surface preparation. The majority are of such recent origin that more time is required to determine their comparative effectiveness.

Some railroads use low-cost grease-type coatings as protection for steel spans, especially floor systems that are subject to spillage. These coatings are not true greases but consist of mixtures of petrolatum and waxes with rust inhibitive chemicals and solvent added. They are available in varying degrees of hardness and hiding power. Some are applied as hot melts but those intended for coatings on structural members are generally applied as cutbacks and thicken or harden upon evaporation of the solvent. These coatings possess excellent wetting characteristics even when applied over dirty steel and the strong inhibitors used make them very effective in controlling corrosion so long as the inhibitors are not leached out and carried away. Grease coatings remain relatively soft and slippery, especially during warm weather and require frequent renewal when exposed to severe weathering conditions; however, the low initial cost make them attractive for use where other less desirable characteristics can be tolerated.

No single coating material yet available possesses all of the properties required of a perfect maintenance coating. Each has its own distinct properties which make it valuable under specific conditions. There is a wide overlapping of these properties and characteristics. This generally makes possible considerable variation in selecting a paint system that may prove satisfactory for a specific bridge.

Other methods

It is sometimes difficult to justify the cost of painting some railroad bridges on a basis of protection alone. Structural steel does not corrode when exposed in the atmosphere under normal conditions unless the relative humidity is above 70% and even then the rate may be very low. Even though a small uniform loss of metal does occur, it may be economical to provide a small additional thickness of metal to compensate for that expected to be lost through the corrosion processes during the expected life. It is also possible to use one of the low alloy steels with a lower corrosion rate. The additional cost for material in either case may be less than the cost for painting over the ensuing year.

Serious corrosion damage is seldom proportional to the volume of metal affected. Critical loss of metal generally occurs in localized regions as the result of faulty design which allows water to accumulate or be trapped along with soil, chemical contaminants, or other debris. In some cases the steel may be in contact with materials that absorb water and do not dry quickly or may be strongly cathodic to the steel and greatly accelerate corrosion.

New specifications

The Steel Structures Painting Council, a nonprofit national organization formed 15 years ago by a group of associations and organizations concerned with the use of paint to protect steel structures and of which this association is an associate member, has issued a new revised edition of Volume II of its Painting Manual. This new edition is now available from the Council whose address is 4400 Fifth Ave., Pittsburgh, Pa. This manual can be used as a complete guide and index for painting steel railroad bridges in addition to many other types of steel structures. Each section has been updated and expanded to take advantage of technical progress and experience gained.

The concept of using a series of numbered paint systems has been retained. This allows the user to specify the entire painting scheme of surface preparation, paint application, paints and special provisions by designating a number.

The surface preparation specifications have been revised with emphasis placed upon end conditions rather than cleaning rates. An additional grade of blast cleaning (near-white) has been added along with new provisions for cleaning welds, rust-back, and the use of photographic standards.

The provisions for use of pretreatments and wash primers have been updated in light of recent experience.

The new paint application specifications provide for use of catalyzed materials, airless spray, hot spray, treatment of contact surfaces, welds and for other special stipulations.

The paint specifications, while not covering every type of material that may be in use, are thought to be sufficient to allow the user to obtain proven primers, intermediate and top coats from reliable suppliers that are suitable for almost any exposure. The recommendations made may not be the only satisfactory ones and are not intended to be a substitute for empirical experience; however, they are believed to be reliable and among the best available at this time.

Abstract

The scope of this subject is so broad and diversified that little detail can be given here. An attempt has been made to outline briefly the nature of corrosion processes that if allowed to continue unabated may eventually destroy a steel structure. Some of the more effective and practicable methods used to prevent or control corrosion is described. Also, reference is made to a reliable and widely used source of information on methods and specifications for painting steel bridges.

The design for a satisfactory protective coating system depends upon so many variables, including the geographical location and consist of traffic, that few specific recommendations are made. Fortunately, the advancements made in coating materials and technology during recent years make possible considerable variation in coating systems that may prove satisfactory to meet individual preferences and difference in opinion that exist among carriers as to what constitutes an economical protective coating system.

Prestressed Concrete Uses in the Railway Industry

Report of Committee

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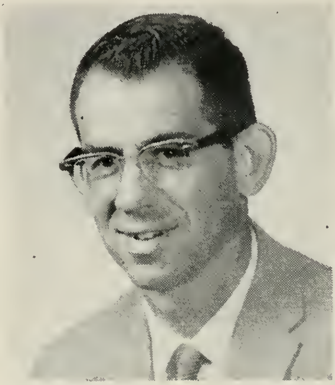
The concept of a prestressed beam to carry a flexural load is approximately 80 years old. The early efforts at prestressing concrete were ineffective because the total loss of prestress was more than the yield point of the available steel. To offset these losses a high-strength steel had to be developed. Such steel was not commercially available during the conception era of prestressing principles. Even considering technological advances on cement manufacture and concrete production methods resulting in relatively high strength concrete, prestress losses are a design consideration and currently restrict the use of prestressing elements to high strength steel.

Practical methods for holding the prestressed force in concrete were advanced by the late Eugene Freyssinet, a French engineer, who received patents on his methods in 1929. He worked with both pre and post tensioned systems and in 1933 wrote that three conditions must be fulfilled: "(1) Use of metals with a very high elastic limit, (2) their tensioning at very high initial stresses, largely over 70,000 psi, and (3) their association with a concrete of very low, constant and wellknown deformability and having a high and regular strength." Thus, the advanced knowledge and methods of two materials were united in the use of high-strength concrete and high-strength steel, resulting in the fundamental relationship necessary to commercially produce prestressed concrete.



M. C. Davidson
Chairman

Prestressing principles have been more widely used in Europe than in the United States. Modern prestressed concrete was first used for pipes, tanks and domes—circular prestressing. The first application of linear prestressing in the United States was the 1947 construction of a warehouse floor slab in Chicago and in 1948 a prestressed deck for a suspension footbridge across the Delaware at Luberville, Pa., both by the John A. Roebling's Sons Corp. The first major prestressed concrete bridge in the United States is the Walnut Lane Bridge in Philadelphia, Pa., which was constructed in 1949. Pioneering engineers were cognizant of the power of the new tool they now had at their disposal and primarily looked to Europe for guidance in its use; however, European practice was geared to lower labor costs than the United States.

Many miles of timber trestle have reached the limit of their useful life on railroads and must be renewed and replaced by other structures, or filled in order to allow continued safe operation. Increasing axle loads and the increasing demand to handle heavy duty car loadings combine to produce higher stresses with more frequent loadings in railway track and structures, as opposed to the maximum loadings in the past being dominated by locomotives and tenders with only one maximum stress per train. As the initial and maintenance cost of supporting track and bridge structures increase to support these heavier loads and the cost of maintenance also rises with increasing construction costs, it becomes imperative that railway engineers seek the most economical, sound structure for investment purposes. Existing permanent-type structures are not excepted from this consideration. It then becomes a problem to determine what type structure is the best investment under particular circumstances at a specific location. The problem is complicated by the consideration of present and possible future traffic volume and loadings over the track which is in need of repair or replacement.

Advantages

The advantages of prestressed concrete are numerous:

(1) Superior durability to freezing and thawing in the presence of brine.

(2) Decreased depth of members when compared with an equivalent conventional concrete design.

(3) Precompression assists the shear capacity of the beam.

(4) Utilization of efficient methods both in the production of structural elements and field erection.

(5) Prestressing combines the best characteristics of two of the foremost construction materials—compressive strength of concrete twice as strong as ordinary concrete but only 10% to 20% more expensive and high-strength steel which is five times stronger than ordinary steel but only three times more costly.

(6) Precasting, together with prestressing, utilizes existing standard forms and shapes, minimizing form costs and producing members which can be erected in the field with a minimum of traffic interference and field labor.

(7) Since the steel is pretensioned above its working load and the prestressing force is transferred to the concrete at an early age before the 28-day strength is obtained, prestressed concrete is partially tested during the prestressing operation—more often it is subjected to higher stresses under these conditions than will exist under working loads.

(8) Fatigue resistance of prestressed concrete members is very high.

(9) Impact is a design factor which can be reduced and is reflected in a different AREA impact formula for prestressed ballast-type bridge structures.

(10) Ultimate strength design requirements provide for anticipated future overloads.

(11) Deflection under load is small, producing excellent riding qualities when camber is not a problem, and

(12) It is a non-combustible permanent-type structure with good fire-resistant qualities when designed and consrtucted properly.

Disadvantages

The disadvantages are:

(1) Primarily the lack of experienced designers, but this is gradually being overcome.

(2) Good quality control of concrete and the prestressing operation and experienced inspectors are needed to assure the adequacy of the long-range investment of the structure.

(3) Long-term effects of camber for concrete creep) under some conditions may be a problem.

(4) Several spans must be produced by the precast-prestressing contractor in order that form set-up time will not be costly.

(5) On small projects standard shapes made with existing forms available should be used for obvious economical reasons.

(6) Dead weight of members sometimes creates problems in field handling.

An important product of prestressed concrete is the railroad crosstie. Prior to the advent of prestressing, reinforced concrete ties had been installed by several railroads. Their performance, however, was not successful. Reinforced concrete simply was not able to withstand the combination of shock loading and the elements. The destruction of track during World War II and a shortage of timber forced European development of a substitute crosstie. The superior qualities of prestressed concrete (for crossties the ability to absorb impact without damage) became evident in European investigations.

Extensive AAR research, investigations, field installations and careful revisions of design based on both laboratory and field experience in the United States, and Canada have resulted in a successful design. Current AAR research and heavy axle main-line loading experience and recommendations are presented in AAR reports ER-20 and ER-58.

Higher initial costs must be balanced through a longer service life, increased track surface and alignment stability (increased operating efficiency), decreased rail accessory costs, reduced delivery costs, less future maintenance expense, and increased tie spacings. For industry tracks and infrequently used side tracks initial costs can also be reduced through tie spacing greater than main-line tracks, elimination of tie pads, and the use of less expensive intermediate concrete support blocks. The manufacture of the prestressed crosstie is a highly efficient process adapted to mass-production techniques —which reduces cost and also makes the crosstie immediately available upon demand.

The scope of this report was to include all uses of prestressed concrete by the railroads, subsequent to committee assignment, however, a summary report has been written concerning prestressed concrete building components by AREA Committee 6, Buildings, which was published in the December, 1964, AREA Bulletin.

In order to accumulate a group opinion of prestressed concrete in the railway industry, this committee conducted a survey of various railway chief engineers. The questionnaire was informal in order to invite opinion and was mailed to chief engineers of 32 American railroads.

There were 466 bridge spans or 86 bridges utillizing prestressed concrete on 23 American railroads as of 1964. Nearly 90% of the roads furnishing information indicated they had some application of prestressed concrete. Highlights of the projects listed include a 122-ft ballast-deck span, E-72 design, composed of a single box girder, on a northwestern railroad. Another railroad is replacing timber caps with precast prestressed concrete caps and timber ties with prestressed ties on open-deck trestles, which are materially competitive in first cost with timber. One line has installed many spans of the AREA through-voided box beams. A central road has completed an open-deck prestressed concrete bridge with only one box beam per rail. Based on its experience this railroad will construct a bridge with a longer optimum span length utilizing this type of structure. Another railroad has been replacing timber trestle with ballast-deck prestressed concrete beams and piling from 1200 to 2000 ft of bridge annually since 1961.

The primary reason given for using prestressed concrete was durability with less future maintenance expense, combined with longer service life. Many roads indicated they liked the fire-resistant qualities of a permanent-type structure. Less traffic interference, lower first costs in place, and the higher salvage value and/or reuse were also listed as advantages. The railroad with the greatest use of prestressed concrete piling said that "prestressed concrete piles can be transported, handled and driven without damage by cracking encountered in conventional precast piles."

Over 75% of those railroads supplying information indicated that they were considering the use of prestressed concrete. It was interesting to note about 80% of the railroads considering further use or planning for prestressed concrete work have used it in the past. A few roads that have satisfactory past experience with prestressed concrete are not planning on its use in the near future.

Sixteen of the seventeen respondents that had used prestressed concrete are satisfied with its performance. The other reserved comment because its facility was not open to traffic. Fifteen of the polled railroads using prestressed concrete have not as yet experienced any maintenance problem.

An independent analysis indicates approximately 65% of the existing railway prestressed concrete bridges in the United States are owned by railroads supplying information for this report. The railroad with the longest experience reports a ballast parapet on a precast slab cracked, and its recommended solution is "to cash the parapet after prestressing." The railroad with the most extensive use of prestressed concrete and eight years experience reported satisfactory service and no maintenance problems.

Some lines are looking to prestressed concrete for solutions to particular problems, while others indicated interest in open-deck prestressed concrete bridges for economic trestle replacement with the idea of future reduction in B&B maintenance. One railroad is considering prestressed concrete for replacing a long trestle on off-set alignment over swampy ground where long spans on 2 or 3-pile bents may be advantageous. A major user of prestressed bridges is looking toward longer spans to provide better economies.

Over half of the lines reported that they were considering the use of prestressed concrete to replace timber trestles, and nearly half anticipated the use of prestressed concrete to replace more permanent-type bridges. Only four of the railroads surveyed indicated any extensive interest in prestressed concrete building components through utilization of centralized and efficient casting yards and/or standardized efficient methods of construction.

Nine railroads reported use of prestressed concrete piling and several others have plans to use it in the future. Of the nine railroads that have used prestressed piling seven are planning on its future use and two do not have plans for its future use. Of the ten railroads that have not used prestressed concrete piling, four are planning on its future use and six were not considering it.

In comparing established trestle design with some of the more recent engineering developments (prestressed concrete and composite concrete with steel or prestressed concrete) and with the added consideration of more frequent and heavier axle car loadings than in the past with locomotives, slightly more roads preferred prestressed concrete than preferred timber trestles. Also, about as many preferred an open-deck trestle as those that desired a ballast deck. Some railroads anticipate future trestle designs of conventional concrete and of steel spans. A minority indicated interest in composite design.

When consideration is given to tax depreciation rules and intangible costs such as fire, future maintenance expense, rising labor and materials costs, future renewal costs and other expenses, in regard to the relative costs of prestressed concrete bridge as compared with other materials (steel, wood or reinforced concrete) it appears that many railroads lean toward the use of prestressed concrete.

For trestle replacement most lines selected timber as having the lowest first cost, and for long-range overall costs nearly 40% listed prestressed concrete as being the most economical bridge material. On longer spans the ratio was three to one in favor of steel over prestressed concrete as having the lowest first cost. For overall costs of long spans only 12% indicated prestressed concrete was the most economical as compared with steel.

There were some replies indicating desire for more bridge standardization. In the analysis main-line loadings were given primary consideration. It is also recognized that individual railroads must give primary consideration to available funds to maintain the railroad in their evaluation of particular preferences for various construction materials. Some railroads indicated more than one economic preference which would appear to stipulate local competition.

A few railroads have used lightweight aggregate in conjunction with prestressed concrete, and the majority of these reported uses in building components only. One railroad reported, use of expanded shale in a TOFC walkway of 4-ft wide "T" sections spanning 30 ft, using 5000 psi concrete.

The world's first prestressed concrete railroad bridge was constructed in Brussels, Belgium, in 1942. Prestressed concrete is the dominant construction material in Europe. It is significant that the oldest prestressed concrete structures in the world are in Europe and are proving exceptionally durable when compared with their conventionally reinforced counterparts, i.e., piers, abutments, and bridge seats. Europe has constructed three-way prestressed concrete bridges, prestressed concrete trusses, and many other unique designs. France, Great Britain and West Germany seem to be leading in advanced techniques of prestressed concrete and are joined by Russia to lead the world in quantity produced. Reliable sources have reported that prestressed concrete is used exclusively in Russia for railroad spans up to 33 meters (108 ft).

The largest single collection of short-span prestressed concrete railway bridges in the world is on the rehabilitated 750 miles of Queensland Railways in Northern Australia. Two basic span lengths, 30 ft and 45 ft, with bid specifications including conventional concrete or steel, with the option of alternative designs, stimulated competitive bidding. The winning design was prestressed concrete. In a little over two years, some 550 spans totalling 20,500 ft of bridging were installed. A unique through-girder design in 1959 spanning 110 ft over a city road was constructed with a prestressed concrete deck stressed longitudinally and transversely to act with the steel girders as part of the *tension* flange.

Since 1961, the use of prestressed concrete for spans 50 ft and over utilizing I-beams and insitu composite deck, or T-beams has increased. Contracts allowing the use of either steel or prestressed concrete have consistently favored the latter, with the economic advantage being as high as 15% in some instances. A recent prestressed structure over the Colliope river on the central coast is 990 ft long with 80-ft approach spans and main spans of 143 ft made up of double cantilevers. AREA specifications are primarily used.

The rehabilitation of the Great Northern line or Mt. Isa project, replacing timber bridges with standardized prestressed concrete spans, was completed between 1960 and mid-1964. To date the only difficulties have been with shrinkage and other minor cracks which were faults in design and detailing, rather than the material itself. It is anticipated that usage will increase in all fields except in remote locations where the weight problems makes handling difficult.

The new Japanese line from Tokyo to Osaka primarily utilizes prestressed concrete ties. Trestles are standardized rigid frames of conventional concrete designed for seismic loadings. Also of interest in Japan is an 8.2-mile monorail which will carry an average of 101,500 passengers daily. Except over highways, rivers and in some other sections the rapid transit rides on one voided prestressed box beam 31½ in wide by 55 in deep, spanning standard lengths of 65.8 ft, 49.3 ft (in the tunnels) and 32.9 ft. These box beams are designed for live loading, impact, lateral loading, centrifugal force, wind loading, and seismic loading. The shoes for the beams were designed to take overturning, change in length from temperature, track adjustment, lateral loading, and vertical loading.

In Mexico on the recently (1961) completed line between Creel and San Pedro, five prestressed steel girders with insitu composite decks (ballast deck) result in up to 55% savings in weight of steel and 25% of first costs. Design loading is for Cooper's E-50 with spans from 39 to 82 ft. Several prestressed concrete bridges utilizing both precast and cast-in-place concrete span deep canyons in the high Sierra Madres. Typical prestressed beams are 102 ft long, 5 ft 11 in deep, weighing 40 tons each. Bridges used three beams and cast in place the transverse diaphrams and deck (composite) which were then prestressed. Curbs to retain the ballast were cast later.

Some of the latest techniques in Europe reported to this committee are the casting of beams with external grooves for the prestressing steel, then post-tensioning steel located in these grooves and grouting over the post-tensioned steel. The method is used for large beams where shipping is prohibitive and labor is abundant and provides accurate visual inspection of the prestressed steel. Prestressed concrete girders have been constructed under an existing reinforced concrete railway bridge with spans up to 20 meters (65.6 ft). Tunnel linings of rectangular section with a wall thickness of 22 cm. (8.7 in) have been found to be suitable for the Moscow underground railway through full-scale tests.

Canada is constructing what is believed to be the first prestressed continuous railway bridge in North America. Intricate reinforcement and cables have made it a slow job. The budget box beams are 112 ft long.

From the survey railroads are considering replacement of timber trestles with prestressed concrete (where feasible) for economic reasons, primarily the reduction of future maintenance costs, to build up their property to meet competition with longer-lasting structures which are non-combustible. In 1963 there were 205 fires (4.91% of all railway fires) on bridges, trestles and culverts amounting to $1.23 million (9.5% of total losses).

In regard to railway labor costs, average wage rates have increased 81% since 1950 while the number of employees has decreased, resulting in almost complete over-all wage stabilization costs. Maintaining slow rail traffic through construction not only increases operating costs over an extended period but in many instances allows very little work to be accomplished. Thus labor costs and operating costs are compounded both in railway construction and maintenance. These factors contribute to the desire for permanent type structures with minimum traffic interference and less future maintenance.

In 1958 there were approximately 1800 miles of timber bridges or approximately 40% of the total bridge mileage. There were about 1800 miles of steel bridges and 900 miles of concrete bridges. The potential replacement expenditure demands carefully deliberation by each railroad to develop an economic program suitable to available funds, with due consideration to reduce future expenditures and provide structures to carry anticipated loadings. Such a program should include careful investigation to pinpoint structures in disrepair and to anticipate future needs. The factors given consideration should include the future demands (loadings, traffic volume, and bridge site conditions) and the most economic means to serve these future demands.

There are two motivating forces which will primarily make or break a new product on the market in our free enterprise system. One is the ability to produce a better product and the other is to be more competitive than existing available products. Prestressed concrete possesses both of these qualities. Still it must also meet new competitive products and processes. Some of these are also making headway—composite design, glued laminated wood, fire protective coatings, prestressed steel, and the combined concept of prestressing a steel beam with a composite deck. Such designs should be evaluated by railway-oriented engineers familiar with railway operating conditions to assure satisfactory performance. Railway managements are in a period of upgrading their properties to reduce future maintenance and operating costs while also taking advantage of tax depreciation rules with accumulating rewards. Just how much should be invested to avoid compounding future expenditures rests with each individual railroad. A particular advantage to railroads is that the consideration of prestressed concrete has created a reliable competitive product to challenge established products.

Training Bridge and Building Supervisors

Report of Committee

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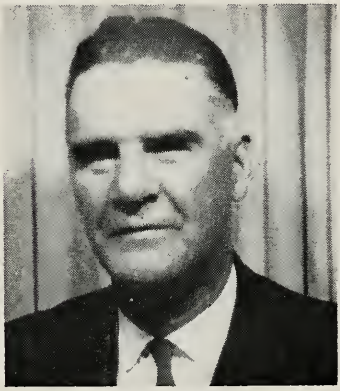

C. E. Wachter
Chairman

The word "supervisor" is defined in Webster's dictionary as an individual who is in charge of overseeing or directing work, workers or projects. It follows that the objective of his direction and efforts is attained by his coordination of the abilities and endeavors of the people assigned to his sphere of activity and over whom he has jurisdiction. It also follows that the supervisor must attain his objective in a manner wherein quality and sound economic policy are kept in proper perspective, and one is not over-emphasized at the expense of the other. In addition, his objectives must be reached while remaining within the framework of company policy.

If the preceding is regarded as an objective evaluation of the scope of a supervisor's responsibilities and duties, where then are the railroads of America to find personnel with the proper qualifications and, of equal importance, how are they to be trained. These two vitally important questions can best be answered in the order of their occurrence: (1) Selection of qualified personnel; (2) proper training of the individual in the various phases of his job responsibility.

Historically the railroad industry has advanced qualified personnel to the position of bridge and building supervisor from the ranks of the Engineering Departments and, in exceptional cases, has taken promising young men from other departments. At the present time, however, the industry as a whole is lacking in qualified candidates for the position due to a sharp drop in the number of men added to the ranks in recent years, and the limited number of college-trained men available. The pool of available talent is thus restricted almost entirely to employees who are now too old or simply do not wish the added responsibility. The situation, while not critical, has assumed serious proportions and the industry must review and re-evaluate the training programs now in effect.

What are the qualifications a bridge and building supervisor should possess? In addition, which of the desired qualities are inherent and which can be acquired? And, if the individual does not possess the requisite qualifications, how are we to train him to insure that he will become a capable supervisor? Another important question which will arise is that of age. A training program intended to develop people for positions of responsibility will be very expensive for any company and, as any other investment, must provide an adequate return on invested capital.

Ideally, the individual or individuals selected to participate in training programs intended to develop bridge and building supervisors should possess a Bachelor's Degree in Civil Engineering and, if at all possible, two or three years of experience in the field of general construction. While experience does a great deal to mature and develop the confidence of the individual, it is only one of several essential criteria, and a deficiency in this respect should not preclude acceptance as a supervisor in training. A successful supervisor is of necessity a skillful organizer and he should also possess the ability to maintain congenial relations with his superiors and subordinates without sacrificing employee discipline or efficiency.

As the industry is in a period of rapid evolution with ever-changing concepts and new technological methods becoming routine, the prospective supervisor must be able to quickly adapt his thinking and planning to new and more complex situations. In addition, the trainee should have a good understanding of office routine, budgetary matters, payroll procedures, material invoices and the requisitioning process.

We have, of course, described the ideal candidate for a supervisory training program with the realization that it would be virtually impossible to obtain someone who possesses the preceding qualifications and remain within the salary range presently authorized by the industry. In addition, such a man is in all probability ambitious and promotion is seldom equivalent to his education and ability.

Recognizing this, we must then modify the requirements imposed upon the individual with the thought in mind that the individual is to be upgraded to meet the requirements of the position. This can be accomplished by shifting the emphasis of the technical and practical aspects of the training program as required. The extent to which the program is altered is, naturally, dependent upon the people involved.

We should then consider a person with a Bachelor's Degree in the related fields of general engineering or industrial arts. Lacking this, the employer should insist that the candidate possess a high-school diploma with a solid background in mathematics and science coupled with a certain number of years of practical experience. The latter category will, if possible, include employees from the ranks of the bridge and building department. With regard to employees from the ranks, it would be very desirable if the high-school diploma were supplemented with credits from technical or correspondence schools. In this connection, the employing organization might, as a means of furthering technical knowledge among qualified people, arrange to participate in the costs of such programs by refunding the cost of tuition and textbooks. This will serve to stimulate interest in a training program and prove to be a morale builder.

Whenever a training program is initiated by a company, the question of age poses a difficult problem. Beyond what age does a man become unacceptable as a participant in a training program by virtue of the fact that his remaining years of activity are too few to warrant the substantial amount the company must invest to train him? Again, if the employer has established a maximum age limit for trainees, can exceptions be made? The answers to these questions must, of course, be made in the light of company policy and the relative abilities of the individuals involved. Your committee feels, however, that upon completion of a period of training, the man should have a minimum of twenty-five years of active service remaining. This will give the individual and the company ample time to reap maximum benefits from the training program.

Men who fall within the specified age limit and possess the required experience and educational qualifications, and are willing to enter a training program, should then be subjected to a series of psychological tests currently used by personnel departments. These tests will, if properly administered, evaluate the inherent skills and personal traits of the individual which are not always evident during interviews nor can they be detected by observation. Indeed, as a means of formulating an objective view of the candidate these tests represent an indispensable must for the railroad industry. If, as a result of the testing, the prospective trainee is found to be deficient in these important personal qualifications, he should not receive further consideration.

After management has selected an individual to enter a training program which may, if he satisfactorily meets all requirements, lead to his appointment as a supervisor of bridges and buildings, how should we proceed to train him? Should a preponderance of his training be concerned with technical subjects or must the practical aspects of the job be stressed? How much weight should be given to the related problems of safety, labor relations and human relations? And, of vital importance, how is the training program to be administered? Should the program be administered locally, i.e. on a divisional basis, or should it be directed by the chief engineer?

First let us consider the question of administration, since this problem would, quite naturally, be the first to arise in the event a railroad company decided to initiate a training program. We believe that the only feasible method of administering such a program is to place it under the direction of the chief engineer or someone who is directly responsible to him. This would assure a uniformity and continuity of the program which would be lacking if the program became a local affair.

If a training program becomes the responsibility of the division superintendent or the division engineer, it will eventually pass into limbo. Such a result is inevitable because of the pressure of daily routine to which divisional officers are subject. In addition, due to a shortage of supervisory personnel, or perhaps because the trainee may excel in certain phases or bridge and building work, the local officer may be tempted to assign the man to such work, and thereby defeat the intent of the program.

Since people of varying abilities will be assigned to any training program, the scope of such a program must remain flexible to permit the individual to utilize his time in a manner most advantageous to him. For example: the college graduate will wish to spend more time on practical problems, while his counterpart with a lesser education will naturally seek to enhance his abilities along technical lines. Thus, rather than set rigid time limits on various phases of the program, the individual should be permitted to progress through each phase of the program at a pace commensurate with his abilities, subject, of course, to the approval of the supervising officer.

Training should begin, preferably, at an important center of operations with all expenses borne by the company. Here the trainee will enter a period of intensive technical study and orientation covering a period of from four to six months during which he will be exposed to basic principles of mathematics, drafting, blueprint reading, construction and, of great importance, mechanical equipment and machinery. During this phase of his training, it would be well if he were exposed to the thinking and goals of management. This could be accomplished by having the various department heads arrange to speak to the trainees and explain to them the organization and missions of their departments. In connection with these talks, each speaker should submit to question and answer period.

Another extremely important topic which must receive thorough study at this time, is the subject of labor relations. The prospective supervisor must realize that he is to be the first link in the chain of communication between management and employees belonging to a union. It is he who must administer the agreement between the carrier and the employees, and it is he who must make the daily decisions in this area which fall within the scope of his authority. If he is to become a competent administrator in the area of labor relations a thorough knowledge of the current agreement is indispensable.

This period of instruction and orientation should be followed by an assignment to a bridge and building gang or crew engaged in diverse types of construction work. The duration of this phase of the training program should be from six to eight months with the previous practical experience and aptitude of the trainee being the governing factors determining his stay. Here he will be exposed to all types and methods of bridge and building work and, of extreme importance, he will have the opportunity to observe and perhaps practice the organization and direction of projects.

This is also an opportune time to acquaint the trainee with the always important problem of safety. He will learn that the role of the supervisor in a safety program is second to none since he bears prime responsibilities for the conduct of projects in the field with the collateral obligation of ascertaining that the work is performed with due regard to safety. Failure of the supervisor to insist that work be performed in a safe manner often leads to human tragedy and a not incidental expense to the employer.

This phase of the program may prove to be invaluable to the people responsible for its success because, to use a truism, it will in all probability, tend to "separate the men from the boys."

Following his tour with a gang in the field which, incidentally, should be scheduled during the summer months, the trainee may, provided he has displayed the requisite qualifications be assigned as a general foreman or inspector. In some instances, if the man is an outstanding prospect, he may be assigned as an assistant bridge and building supervisor. In these positions the individual will have the opportunity to apply to practical projects the principles and knowledge absorbed in his previous training. He will be exposed to office routine, budgetary practice, labor problems, estimating, etc. If he is fortunate, the supervisor to whom he reports may permit him to exercise responsibility in direct proportion to his ability and, in so doing, he will gain confidence in his ability and judgement.

The length of this period of apprenticeship will be entirely dependent on the individual and will vary a great deal. Some may fall by the way and, should this occur, the man should be permitted to return to his former occupation or assigned to other duties. If, however, the outlook and the abilities of the trainee are in no way comptaible with the desired result and, if he does not hold union seniority, it might be well for all concerned if he were separated from the company. Others in the training program may quickly demonstrate their readiness for a supervisor's position and, when openings occur, be promoted. Merit should, without question, play the predominant role in all promotions.

From the moment a man is chosen to participate in a training program, and until he either fails or succeeds in the prescribed course of training, he should remain under the intensive scrutiny of the people charged with administration of the program. They should request progress reports from his immediate superior and others closely connected with the program who are in a position to make an accurate evaluation of his development. The latter arrangement will aid a great deal in maintaining an objective record of the progress of the trainee and prevent the intrusion of personalities. In connection with the progress reports, the trainee should, at regular intervals, be required to participate in an evaluation session with a person or persons chosen by the chief engineer. At these sessions the record of the trainee can be thoroughly analyzed and constructive suggestions offered on ways and means of improving his performance.

A further check on the progress of the supervisor-in-training can be made by requesting a monthly report from him giving a detailed account of his activities for that period. This will give supervising officers frequent opportunities to alter the program in a manner appropriate to the requirements of the individual. In these reports the trainee could also make suggestions dealing with deficiencies in the training program.

A very important factor in a training program is that of salary administration. As the trainee progresses through the course and his knowledge and responsibilities increase, he should receive periodic increases in salary commensurate with his progress and ability. This will serve as a morale booster and provide him with added incentive to strive for improvement.

As an integral part of a training program, the trainee should be encouraged to actively participate in the work and programs of the various engineering associations. Association membership is voluntary but will allow him to receive invaluable information from their published reports. In addition, involvement in committee work serves as a spur to the man to seek new information and he, of course, receives the benefit of the thinking of his counterparts in the industry.

The course of training as outlined in the preceding paragraphs is not intended to be a strict model for future training in the railroad industry. The ideas set forth in this paper are only a few of the large number submitted by members of the committee. It is hoped, however, that this report will prove beneficial to those railroads contemplating supervisory training programs.

In this connection the leaders of the railroad industry must be alerted to the fact that our sources of supervisory talent are practically non-existent. Because of the lower salary scale now in effect coupled and often based on seniority rather than ability, the nation's railroads are experiencing difficulty in attrracting qualified people. In addition, with smaller work forces maintaining large territories, the number and caliber of people hired is sharply limited which further constricts the pool of available talent. Finally, the people who may be supervisory material —the incumbent foremen and inspectors —are generally beyond the age where it is economically feasible to train them for these positions. This makes it imperative for railroad management to devise new methods and programs to attract qualified people to the industry. There can be no doubt that comprehensive training program and an improved salary scale are steps in the proper direction.

HISTORICAL INFORMATION

List of Annual Conventions

No.	Place of Meeting	Date	Membership
1	St. Louis, Mo.	Sept. 25, 1891	60
2	Cincinnati, Ohio	Oct. 18–19, 1892	112
3	Philadelphia, Pa.	Oct. 17–19, 1893	128
4	Kansas City, Mo.	Oct. 16–18, 1894	115
5	New Orleans, La.	Oct. 15–16, 1895	122
6	Chicago, Ill.	Oct. 20–22, 1896	140
7	Denver, Colo.	Oct. 19–21, 1897	127
8	Richmond, Va.	Oct. 18–19, 1898	148

No.	Place of Meeting	Date	Membership
9	Detroit, Mich.	Oct. 17–19, 1899	148
10	St. Louis, Mo.	Oct. 16–18, 1900	143
11	Atlanta, Ga.	Oct. 15–17, 1901	171
12	Minneapolis, Minn.	Oct. 21–23, 1902	195
13	Quebec, Canada	Oct. 20–22, 1903	223
14	Chicago, Ill.	Oct. 18–20, 1904	293
15	Pittsburgh, Pa.	Oct. 17–19, 1905	313
16	Boston, Mass.	Oct. 16–18, 1906	340
17	Milwaukee, Wis.	Oct. 15–17, 1907	341
18	Washington, D. C.	Oct. 20–22, 1908	368
19	Jacksonville, Fla.	Oct. 19–21, 1909	393
20	Denver, Colo.	Oct. 18–20, 1910	428
21	St. Louis, Mo.	Oct. 17–19, 1911	499
22	Baltimore, Md.	Oct. 15–17, 1912	524
23	Montreal, Quebec	Oct. 21–23, 1913	570
24	Los Angeles, Cal.	Oct. 20–22, 1914	586
25	Detroit, Mich.	Oct. 19–21, 1915	665
26	New Orleans, La.	Oct. 17–19, 1916	710
27	Chicago, Ill.	Oct. 16–18, 1917	704
28	Chicago, Ill.	Oct. 15–17, 1918	716
29	Cleveland, Ohio	Oct. 21–23, 1919	776
30	Atlanta, Ga.	Oct. 26–28, 1920	840
31	New York, N. Y.	Oct. 18–20, 1921	850
32	Cincinnati, Ohio	Oct. 17–19, 1922	865
33	Seattle, Wash.	Oct. 16–18, 1923	846
34	Kansas City, Mo.	Oct. 21–23, 1924	837
35	Buffalo, N. Y.	Oct. 20–22, 1925	759
36	Richmond, Va.	Oct. 12–14, 1926	750
37	Minneapolis, Minn.	Oct. 18–20, 1927	754
38	Boston, Mass.	Oct. 23–25, 1928	755
39	New Orleans, La.	Oct. 15–17, 1929	755
40	Louisville, Ky.	Oct. 21–23, 1930	713
41	Chicago, Ill.	Oct. 16–18, 1934	592
42	Chicago, Ill.	Oct. 15–17, 1935	547
43	Chicago, Ill.	Oct. 20–22, 1936	588
44	Chicago, Ill.	Oct. 19–21, 1937	566
45	Chicago, Ill.	Oct. 18–20, 1938	589
46	Chicago, Ill.	Oct. 17–19, 1939	546
47	Chicago, Ill.	Oct. 15–17, 1940	610
48	Chicago, Ill.	Oct. 14–16, 1941	594
49	Chicago, Ill.	Oct. 20–22, 1942	618
50	Chicago, Ill.	Oct. 20–21, 1943	597
51	Chicago, Ill.	Sept. 17–19, 1946	698
52	Chicago, Ill.	Sept. 16–18, 1947	651
53	Chicago, Ill.	Sept. 20–22, 1948	652
54	Chicago, Ill.	Sept. 12–14, 1949	676
55	Chicago, Ill.	Sept. 18–20, 1950	713
56	Chicago, Ill.	Sept. 17–19, 1951	676
57	Chicago, Ill.	Sept. 15–17, 1952	667
58	Chicago, Ill.	Sept. 15–17, 1953	666
59	Chicago, Ill.	Sept. 13–15, 1954	682
60	Chicago, Ill.	Sept. 19–21, 1955	625
61	Chicago, Ill.	Sept. 18–20, 1956	657
62	Chicago, Ill.	Sept. 23–25, 1957	769
63	Chicago, Ill.	Sept. 15–17, 1958	828
64	Chicago, Ill.	Sept. 15–17, 1959	863
65	Chicago, Ill.	Sept. 19–21, 1960	932
66	Chicago, Ill.	Sept. 18–20, 1961	968
67	Chicago, Ill.	Sept. 10–12, 1962	942
68	Chicago, Ill.	Oct. 14–16, 1963	887
69	Chicago, Ill.	Sept. 14–16, 1964	860
70	Chicago, Ill.	Sept. 13–15, 1965	829

Past Officers

	1891-1892	1892-1893	1893-1894	1894-1895
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	G. W. Turner	Floyd Ingram	James H. Travis	J. L. White
	J. E. Wallace	A. S. Markley	J. H. Cummin	A. Shane

	1895-1896	1896-1897	1897-1898	1898-1899
President	W. A. McGonagle	James Stannard	Walter G. Berg	J. M. Cummin
1st V.-Pres.	L. K. Spafford	Walter G. Berg	J. H. Cummin	A. S. Markley
2nd V.-Pres.	James Stannard	J. H. Cummin	A. S. Markley	C. C. Mallard
3rd V.-Pres.	Walter G. Berg	A. S. Markley	G. W. Hinman	W. A. Rogers
4th V.-Pres.	J. H. Cummin	R. M. Peck	C. C. Mallard	J. M. Staten
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	George M. Reid	N. W. Thompson	N. W. Thompson	N. W. Thompson
Executive Members	R. M. Peck	W. O. Eggleston	G. J. Bishop	Wm. S. Danes
	L. J. White	W. M. Noon	C. P. Austin	J. H. Markley
	A. Shane	J. M. Staten	M. Riney	W. O. Eggleston
	A. S. Markley	G. J. Bishop	Wm. S. Danes	R. L. Heflin
	W. M. Noon	C. P. Austin	J. H. Markley	F. W. Tanner
	J. M. Staten	M. Riney	W. O. Eggleston	A. Zimmerman

	1899-1900	1900-1901	1901-1902	1902-1903
President	Aaron S. Markley	W. A. Rogers	W. S. Danes	B. F. Pickering
1st V.-Pres.	W. A. Rogers	W. S. Danes	B. F. Pickering	C. C. Mallard
2nd V.-Pres.	J. M. Staten	B. G. Pickering	A. Shane	A. Shane
3rd V.-Pres.	Wm. S. Danes	A. Shane	A. Zimmerman	A. Zimmerman
4th V.-Pres.	B. F. Pickering	A. Zimmerman	C. C. Mallard	A. Montzheimer
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	N. W. Thompson	N. W. Thompson	N. W. Thompson	N. W. Thompson
Executive Members	T. M. Strain	T. M. Strain	A. Montzheimer	W. E. Smith
	R. L. Heflin	H. D. Cleaveland	W. E. Smith	A. W. Merrick
	F. W. Tanner	F. W. Tanner	A. W. Merrick	C. P. Austin
	A. Zimmerman	A. Montzheimer	C. P. Austin	C. A. Lichty
	H. D. Cleaveland	W. E. Smith	C. A. Lichty	W. O. Eggleston
	A. Montzheimer	A. W. Merrick	W. O. Eggleston	J. H. Markley

	1903-1904	1904-1905	1905-1906	1906-1907
President	A. Montzheimer	C. A. Lichty	J. B. Sheldon	J. H. Markley
1st V.-Pres.	A. Shane	J. B. Sheldon	J. H. Markley	R. H. Reid
2nd V.-Pres.	C. A. Lichty	J. H. Markley	R. H. Reid	J. P. Canty
3rd V.-Pres.	J. B. Sheldon	R. H. Reid	R. C. Sattley	H. Rettinghouse
4th V.-Pres.	J. H. Markley	R. C. Sattley	J. P. Canty	F. E. Schall
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	C. P. Austin	C. P. Austin	C. P. Austin	C. P. Austin
Executive Members	R. H. Reid	W. O. Eggleston	H. Rettinghouse	W. O. Eggleston
	W. O. Eggleston	A. E. Killam	A. E. Killam	A. E. Killam
	A. E. Killam	H. Rettinghouse	J. S. Lemond	J. S. Lemond
	R. C. Sattley	J. S. Lemond	C. W. Richey	C. W. Richey
	H. Rettinghouse	W. H. Finley	H. H. Eggleston	H. H. Eggleston
	J. S. Lemond	C. W. Richey	F. E. Schall	B. J. Sweatt

	1907-1908	1908-1909	1909-1910	1910-1911
President	R. H. Reid	J. P. Canty	H. Rettinghouse	H. Rettinghouse
1st V.-Pres.	J. P. Canty	H. Rettinghouse	J. S. Lemond	F. E. Schall
2nd V.-Pres.	H. Rettinghouse	F. E. Schall	F. E. Schall	A. E. Killam
3rd V.-Pres.	F. E. Schall	J. S. Lemond	A. E. Killam	J. N. Penwell
4th V.-Pres.	W. O. Eggleston	A. E. Killam	J. N. Penwell	L. D. Hadwen
Secretary	S. F. Patterson	S. F. Patterson	C. A. Lichty	C. A. Lichty
Treasurer	C. P. Austin	C. P. Austin	J. P. Canty	J. P. Canty
Executive Members	A. E. Killam	J. N. Penwell	W. Beahan	T. J. Fullem
	J. S. Lemond	Willard Beahan	F. B. Scheetz	G. Aldrich
	C. W. Richey	F. B. Scheetz	L. D. Hadwen	P. Swenson
	T. S. Leake	W. H. Finley	T. J. Fullem	G. W. Rear
	W. H. Finley	L. D. Hadwen	G. Aldrich	W. O. Eggleston
	J. N. Penwell	T. J. Fullem	P. Swenson	W. F. Steffens

	1911-1912	1912-1913	1913-1914	1914-1915
President	F. E. Schall	A. E. Killam	J. N. Penwell	L. D. Hadwen
1st V.-Pres.	A. E. Killam	J. N. Penwell	L. D. Hadwen	G. Aldrich
2nd V.-Pres.	J. N. Penwell	L. D. Hadwen	G. Aldrich	G. W. Rear
3rd V.-Pres.	L. D. Hadwen	T. J. Fullem	G. W. Rear	C. E. Smith
4th V.-Pres.	T. J. Fullen	G. Aldrich	C. E. Smith	E. B. Ashby
Secretary	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Treasurer	J. P. Canty	J. P. Canty	J. P. Canty	F. E. Weise
Executive Members	G. Aaldrich	G. W. Rear	W. F. Steffens	W. F. Steffens
	P. Swenson	W. F. Steffens	E. B. Ashby	S. C. Tanner
	G. W. Rear	E. B. Ashby	S. C. Tanner	Lee Jutton
	W. F. Steffens	C. E. Smith	Lee Jutton	F. F. Strouse
	E. B. Ashby	S. C. Tanner	W. F. Strouse	C. R. Knowles
	W. O. Eggleston	Lee Jutton	C. R. Knowles	A. Ridgway

	1915-1916	1916-1917	1917-1918	1918-1919
President	G. W. Rear	C. E. Smith	S. C. Tanner	Lee Jutton
1st V.-Pres.	C. E. Smith	E. B. Ashby	Lee Jutton	F. E. Weise
2nd V.-Pres.	E. B. Ashby	S. C. Tanner	F. E. Weise	W. F. Strouse
3rd V.-Pres.	S. C. Tanner	Lee Jutton	W. F. Strouse	C. R. Knowles
4th V.-Pres.	Lee Jutton	F. E. Weise	C. R. Knowles	A. Ridgway
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Executive Members	F. E. Weise	W. F. Strouse	A. Ridgway	J. S. Robinson
	W. F. Strouse	C. R. Knowles	J. S. Robinson	J. P. Wood
	C. R. Knowles	A. Ridgway	J. P. Wood	A. B. McVay
	A. Ridgway	J. S. Robinson	D. C. Zook	J. H. Johnston
	J. S. Robinson	J. P. Wood	A. B. McVay	E. T. Howson
	J. P. Wood	D. C. Zook	J. H. Johnston	C. W. Wright

	1919-1920	1920-1921	1921-1922	1922-1923
President	F. E. Weise	W. F. Strouse	C. R. Knowles	Arthur Ridgway
1st V.-Pres.	W. F. Strouse	C. R. Knowles	A. Ridgway	J. P. Wood
2nd V.-Pres.	C. R. Knowles	A. Ridgway	J. S. Robinson	J. S. Robinson
3rd V.-Pres.	A. Ridgway	J. S. Robinson	J. P. Wood	C. W. Wright
4th V.-Pres.	J. S. Robinson	J. P. Wood	C. W. Wright	E. T. Howson
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.			F. E. Weise	F. E. Weise
Directors	J. P. Wood	C. W. Wright	E. T. Howson	F. C. Baluss
	A. B. McVay	A. B. McVay	J. H. Johnston	Maro Johnson
	J. H. Johnston	G. A. Manthey	E. K. Barrett	O. F. Dalstrom
	E. T. Howson	E. T. Howson	F. C. Baluss	S. D. Corey
	C. W. Wright	J. H. Johnston	Maro Johnson	W. B. Hotson
	G. A. Manthey	E. K. Barrett	O. F. Dalstrom	P. N. Nelson

	1923-1924	1924-1925	1925-1926	1926-1927
President	J. S. Robinson	J. P. Wood	C. W. Wright	E. T. Howson
1st V.-Pres.	J. P. Wood	C. W. Wright	E. T. Howson	F. C. Baluss
2nd V.-Pres.	C. W. Wright	E. T. Howson	F. C. Baluss	Maro Johnson
3rd V.-Pres.	E. T. Howson	F. C. Baluss	Maro Johnson	J. S. Huntoon
4th V.-Pres.	F. C. Baluss	Maro Johnson	J. S. Huntoon	C. S. Heritage
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.	F. E. Weise	F. E. Weise	F. E. Weise	F. E. Weise
Directors	S. T. Corey	J. S. Huntoon	C. S. Heritage	A. I. Gauthier
	W. B. Hotson	A. I. Gauthier	W. B. Hotson	E. L. Sinclair
	P. N. Nelson	E. L. Sinclair	P. N. Nelson	P. F. Dalstrom
	J. S. Huntoon	C. S. Heritage	A. I. Gautheir	W. T. Krausch
	A. I. Gauthier	W. B. Hotson	E. L. Sinclair	R. C. Bardwell
	E. L. Sinclair	P. N. Nelson	O. F. Dalstrom	H. I. Benjamin

	1927-1928	1928-1929	1929-1930	1930-1934
President	F. C. Baluss	Maro Johnson	J. S. Huntoon	C. S. Heritage
1st V.-Pres.	Maro Johnson	J. S. Huntoon	C. S. Heritage	A. I. Gauthier
2nd V.-Pres.	J. S. Huntoon	C. S. Heritage	A. I. Gautheir	H. I. Benjamin
3rd V.-Pres.	C. S. Heritage	A. I. Gauthier	H. I. Benjamin	W. T. Krausch
4th V.-Pres.	A. I. Gautheir	H. I. Benjamin	W. T. Krausch	T. H. Strate
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.	F. E. Weise	F. E. Weise		
Directors	W. T. Krausch	R. C. Henderson	G. A. Rodman	E. C. Neville
	R. C. Bardwell	J. S. Ekey	W. A. Batey	H. H. Best
	H. I. Benjamin	T. H. Strate	F. W. Hillman	J. E. King
	R. C. Henderson	G. A. Rodman	E. C. Neville	A. B. Scowden
	T. H. Strate	W. A. Batey	H. H. Best	W. A. Batey
	J. S. Ekey	F. W. Hillman	J. E. King	L. C. Smith

	1934-1935	1935-1936	1936-1937	1937-1938
President	H. I. Benjamin	T. H. Strate	E. C. Neville	C. M. Burpee
1st V.-Pres.	T. H. Strate	E. C. Neville	C. M. Burpee	F. H. Masters
2nd V.-Pres.	E. C. Neville	C. M. Burpee	F. H. Masters	W. S. Lacher
3rd V.-Pres.	A. B. Scowden	F. H. Masters	C. A. J. Richards	C. A. J. Richards
4th V.-Pres.	W. R. Roof	C. A. J. Richards	W. S. Lacher	F. H. Cramer
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Directors	C. M. Burpee	A. L. McCloy	W. R. Roof	B. R. Meyers
	W. A. Batey	R. P. Luck	T. P. Soule	G. S. Crites
	L. C. Smith	H. H. Best	F. H. Cramer	R. E. Dove
	C. A. J. Richards	W. R. Roof	B. R. Meyers	T. P. Soule
	A. L. McCoy	T. P. Soule	G. S. Crites	A. Chinn
	R. P. Luck	F. H. Cramer	R. E. Dove	L. G. Byrd

	1938-1939	1939-1940	1940-1941	1941-1942
President	Armstrong Chinn	A. E. Bechtelheimer	H. M. Church	R. E. Dove
1st V.-Pres.	F. H. Cramer	F. H. Cramer	R. E. Dove	F. H. Soothill
2nd V.-Pres.	A. E. Bechtelheimer	H. M. Church	F. A. Soothill	G. S. Crites
3rd V.-Pres.	H. M. Church	R. E. Dove	G. S. Crites	A. M. Knowles
4th V.-Pres.	R. E. Dove	F. H. Soothill	A. M. Knowles	N. D. Howard
Sec.-Treas.	C. A. Lichty	C. A. Lichty		
Secretary			F. O. Whiteman	A. G. Shaver
Treasurer			F. E. Weise	F. E. Weise
Directors	L. G. Byrd	B. R. Meyers	N. D. Howard	R. E. Caudle
	W. R. Ganser	W. Walkden	L. G. Byrd	I. A. Moore
	F. H. Soothill	A. S. Krefting	K. L. Miner	W. A. Sweet
	B. R. Meyers	A. M. Knowles	R. E. Caudle	J. L. Varker
	W. Walkden	L. G. Byrd	I. A. Moore	L. E. Peyser
	A. S. Krefting	K. L. Miner	W. A. Sweet	Martin Meyer

	1942-1943	1943-1944	1944-1945	1945-1946
President	G. S. Crites	J. L. Varker	J. L. Varker	N. D. Howard
1st V.-Pres.	R. E. Caudle	R. E. Caudle	R. E. Caudle	F. G. Campbell
2nd V.-Pres.	A. M. Knowles	N. D. Howard	N. D. Howard	J. S. Hancock
3rd V.-Pres.	N. D. Howard	F. G. Campbell	F. G. Campbell	E. H. Harnhart
4th V.-Pres.	J. L. Varker	J. S. Hancock	J. S. Hancock	W. F. Martens
Secretary	A. G. Shaver† Lorene Kindred‡ Elinor V. Heffern	Elinor V. Heffern	Elise LaChance	Elise LaChance
Treasurer	F. E. Weise	C. R. Knowles	C. R. Knowles	C. R. Knowles
Treasurer Emeritus		F. E. Weise	F. E. Weise	
Directors	M. Meyer	W. F. Martens	W. F. Martens	A. B. Chapman
	L. E. Peyser	A. L. McCloy	A. L. McCloy	W. A. Huckstep
	K. L. Miner	L. C. Winkelhaus	L. C. Winkelhaus	F. R. Spofford
	F. G. Campbell	E. H. Barnhart	E. H. Barnhart	Guy E. Martin
	J. S. Hancock	A. B. Chapman	A. B. Chapman	B. R. Meyers
	L. C. Winkelhaus	L. E. Peyser	L. E. Peyser	L. E. Peyser

†To November 1, 1962
‡To February 1, 1943

	1946-1947	1947-1948	1948-1949	1949-1950
President	F. G. Campbell	J. S. Hancock	E. H. Barnhart	W. F. Martens
1st V.-Pres.	J. S. Hancock	E. H. Barnhart	W. F. Martens	W. A. Huckstep
2nd V.-Pres.	E. H. Barnhart	W. F. Martens	W. A. Huckstep	Guy E. Martin
3rd V.-Pres.	W. F. Martens	W. A. Huckstep	Guy E. Martin	F. R. Spofford
4th V.-Pres.	W. A. Huckstep	G. E. Martin	F. R. Spofford	Lee Mayfield
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	C. R. Knowles	C. R. Knowles	L. C. Winkelhaus	L. C. Winkelhaus
Directors	Guy E. Martin	H. M. Harlow	Lee Mayfield	H. M. Harlow
	B. R. Meyers	H. B. Christianson	F. M. Misch	V. E. Engman
	L. E. Peyser	F. R. Spofford	W. D. Gibson	G. W. Benson
	H. M. Harlow	Lee Mayfield	H. M. Harlow	F. M. Misch
	H. B. Christianson	Franz M. Misch	V. E. Engman	L. R. Morgan
	F. R. Spofford	W. D. Gibson	G. W. Benson	J. A. Jorlett

	1950-1951	1951-1952	1952-1953	1953-1954
President	W. A. Huckstep	Guy E. Martin	F. R. Spofford	Lee Mayfield
1st V.-Pres.	Guy E. Martin	F. R. Spofford	Lee Mayfield	H. M. Harlow
2nd V.-Pres.	F. R. Spofford	Lee Mayfield	H. M. Harlow	J. A. Jorlett
3rd V.-Pres.	Lee Mayfield	H. M. Harlow	J. A. Jorlett	R. R. Gunderson
4th V.-Pres.	H. M. Harlow	J. A. Jorlett	R. R. Gunderson	W. H. Huffman
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
Directors	F. M. Misch	M. H. Dick	W. H. Huffman	M. H. Dick
	L. R. Morgan	R. R. Gunderson	L. R. Morgan	J. F. Warrenfells
	J. A. Jorlett	J. F. Warrenfells	B. M. Stephens	G. Switzer
	M. H. Dick	W. H. Huffman	M. H. Dick	B. M. Stephens
	R. R. Gunderson	L. R. Morgan	J. F. Warrenfells	W. H. Bunge
	J. F. Warrenfells	B. M. Stephens	G. Switzer	E. R. Schlaf

	1954-1955	1955-1956	1956-1957	1957-1958
President	H. M. Harlow	J. A. Jorlett	R. R. Gunderson	W. H. Huffman
1st V.-Pres.	J. A. Jorlett	R. R. Gunderson	W. H. Huffman	M. H. Dick
2nd V.-Pres.	R. R. Gunderson	W. H. Huffman	M. H. Dick	B. M. Stephens
3rd V.-Pres.	W. H. Huffman	M. H. Dick	B. M. Stephens	H. D. Curie
4th V.-Pres.	M. H. Dick	B. M. Stephens	H. D. Curie	
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
Directors	B. M. Stephens	J. F. Warrenfells	W. H. Bunge	G. W. Benson
	W. H. Bunge	H. D. Curie	E. R. Schlaf	J. M. Lowry
	E. R. Schlaf	J. M. Lowry	G. W. Benson	H. A. Matthews
	J. F. Warrenfells	W. H. Bunge	J. M. Lowry	T. M. von Sprecken
	H. D. Curie	E. R. Schlaf	T. M. von Sprecken	W. H. Bunge
	J. M. Lowry	G. W. Benson	H. A. Matthews	E. R. Schlaf

	1958-1959	1959-1960	1960-1961	1961-1962
President	M. H. Dick	B. M. Stephens	H. D. Curie	G. W. Benson
1st V.-Pres.	B. M. Stephens	H. D. Curie	G. W. Benson	J. M. Lowry
2nd V.-Pres.	H. D. Curie	G. W. Benson	J. M. Lowry	E. R. Schlaf
3rd V.-Pres.	G. W. Benson	J. M. Lowry	E. R. Schlaf	H. A. Matthews
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
Directors	J. M. Lowry	W. H. Bunge	H. A. Matthews	R. C. Baker
	R. C. Baker	E. R. Schlaf	M. J. Hubbard	R. H. Miller
	W. H. Bunge	H. A. Matthews	R. C. Baker	Shirley White
	E. R. Schlaf	M. J. Hubbard	R. H. Miller	H. M. Wilson
	H. A. Matthews	R. C. Baker	Shirley White	R. D. Hellweg
	M. J. Hubbard	R. H. Miller	H. M. Wilson	F. W. Hutcheson

	1962-1963	1963-1964	1964-1965	
President	J. M. Lowry	E. R. Schlaf	R. C. Baker	
1st V.-Pres.	E. R. Schlaf	R. C. Baker	H. M. Wilson	
2nd V.-Pres.	H. A. Matthews	Shirley White	R. D. Hellweg	
3rd V.-Pres.	R. C. Baker	H. M. Wilson	J. W. DeValle	
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	
Treasurer	L. C. Winkelhaus	E. F. Snyder	E. F. Snyder	
Directors	Shirley White	R. D. Hellweg	W. F. Armstrong	
	H. M. Wilson	F. W. Hutcheson	J. S. Ellis	
	R. D. Hellweg	W. F. Armstrong	J. A. Goforth	
	F. W. Hutcheson	J. W. DeValle	E. R. Simmons	
	W. F. Armstrong	J. A. Goforth	N. D. Bryant	
	J. W. DeValle	E. R. Simmons	A. R. Dahlberg	

CONSTITUTION

ARTICLE I.

NAME

Section 1. This association shall be known as the American Railway Bridge & Building Association.

ARTICLE II.

OBJECT

Section 1.** The object of this association shall be the advancement of knowledge pertaining to the design, construction and maintenance of railway bridges, buildings, water service facilities, and other structures, by investigation, reports and discussions.

Section 2. The association shall neither indorse nor recommend any particular devices, trade marks or materials, nor will it be responsible for any opinions expressed in papers, reports or discussion unless the same have received the endorsement of the association in regular session.

ARTICLE III.

MEMBERSHIP

Section 1. The membership of this association shall be divided into five classes, viz: Members, life members, associate, honorary and junior members.*

Section 2.** A member shall be a person in a position above rank of gang foreman in connection with roadway bridge, building and water service work, or in the employ of a public regulatory body, a professor of engineering in a college, an engineering editor, or a government or private timber expert. Any person desirous of becoming a member shall make application upon the form prescribed by the executive committee, setting forth his name, age, residence and practical experience. He shall furnish at least three references to whom he is personally known. Applicants may be voted into membership at any regular executive meeting or by letter ballot of the executive committee, a majority vote being necessary in either instance.

Section 3.** To be eligible for a life membership a member must have belonged to the association for at least 15†† years and in general must have retired from active railway service due to age or physical disability. He shall have all the privileges of active membership, except the holding of office, and shall not be required to pay annual dues. The transfer from membership to life membership shall be made in the same manner as the election of members, as prescribed in Section 2, of this Article.

Section 4. Associates shall be responsible persons who are not eligible as members, whose pursuits or attainments qualify them to co-operate with members in the study and development of improved practices in the construction and maintenance of bridges, buildings and water facilities. They shall have all the rights of members except of voting and holding office. They shall be elected in the manner prescribed for members, in Section 2 of this Article.

Section 5. Honorary members shall be chosen from persons who have attained acknowledged eminence in some branch of engineering or railway service. Their number shall be limited to ten. Honorary members shall be proposed by not less than six active members and shall be elected by the unanimous vote of the members present at a regular meeting. They shall have all the rights of active members except that of holding office and shall be exempt from the payment of dues.

Section 6. A junior member shall be a person who is a graduate of a recognized engineering school, or who has been employed for at least two years in the design, maintenance or construction of railway bridges, buildings or structures. Applicants shall be at least 21 years of age and they shall be elected in the manner prescribed for members, in Section 2 of this article. Juniors shall have all the rights of members except that of holding office. When the attainments of a Junior are such as a qualify him as a member, he may apply for promotion and the executive committee shall authorize such promotion when qualifications warrant the action. Unless a Junior is promoted, his membership shall cease automatically when he becomes 28 years of age.*

Section 7. Any member guilty of conduct unbecoming to a railroad officer and a member of this association, or who shall refuse to comply with the rules of this association, shall forfeit his membership on a two-thirds vote of the executive committee.

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* Amended October 16, 1941.

** Amended September 20, 1948.

†† Amended March 10, 1958.

Section 8. Membership shall continue until written resignation is received by the secretary, unless member has been previously expelled, or dropped for non-payment of duties in accordance with Section 1 of Article VII.

Section 9.[**] Only active members shall hold office in this association, and only active and life members shall be entitled to vote in the election of officers.

ARTICLE IV.

OFFICERS

Section 1[†]. The officers of this association shall be a president, three vice-presidents, a secretary, a treasurer and six directors who with the most recent past president shall constitute the executive committee.

Section 2. The past presidents of this association, previous to the most recent past president, who continue to be members, shall be privileged to attend all meetings of the executive committee, at which meetings they shall receive due notice, and be permitteed to discuss all questions and to aid said committee by their advice and counsel; but said past presidents shall not have a right to vote, unless called upon to fill a quorum.

Section 3. Vacancies in any office shall be filled for the unexpired term by the executive committee without delay.

ARTICLE V.

EXECUTIVE COMMITTEE

Section 1.[**] The executive committee shall manage the affairs of the association and shall have full power to control and regulate all matters not otherwise provided for in the constitution and by-laws and shall exercise general supervision over the financial interests of the association, and make all necessary purchases and contracts required to conduct the general business of the association, but shall not have the power to render the association liable for any debt beyond the amount then in the treasury plus accounts receivable and not subject to other prior liabilities. All appropriations for special purposes must be acted upon at a regular meeting of the association.

Section 2. Meetings of the executive committee may be called by a majority of the members of the committee, providing 10 days' notice is given members by mail.

Section 3. Five members of the executive committee shall constitute a quorum for the transaction of business.

ARTICLE VI.

ELECTION OF OFFICERS AND TENURE OF OFFICE

Section 1. Except as otherwise provided the officers shall be elected at the regular annual meeting of the association and the election shall not be postponed except by unannmous consent of the members present at said annual meeting. The election shall be by ballot, a majority of the votes cast being required for election. Any active member of the association not in arrears for dues shall be eligible for office, but the president shall not be eligible for re-election.

Section 2[‡]. The president, three vice-presidents, secretary and treasurer shall hold office for one year and the directors for three years, two directors being elected each year. All officers retain their office until their successors are elected and installed. A director elected for a three-year term shall not be eligible to serve two consecutive terms.

Section 3.[†] The term of office of the secretary and the treasurer may be terminated at any time by a two-thirds vote of the executive committee. Their compensation shall be fixed by a majority vote of the executive committee.

The secretary shall also serve as secretary of the executive committee.

Section 4. The secretary and the treasurer shall be required to give bond in an amount to be fixed by the executive committee.

ARTICLE VII.

MEMBERSHIP FEE AND DUES

Section 1.[†] Every member upon joining this association shall pay to the secretary an entrance fee and dues as prescribed by the executive committee. No member in

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[*] Amended October 16, 1941.

[**] Amended September 20, 1948.

[†] Amended September 21, 1957.

arrears for annual dues shall be entitled to vote at any election and any member more than one year in arrears may be stricken from the list of members at the discretion of the executive committee.

Section 2.‡ A person stricken from the list of members because of non-payment of dues, upon written application may be reinstated as a member in his former class without loss of privileges, either upon payment of all back dues (which must accompany applicants) or at the discretion of the executive committee voting in the manner prescribed in Section 2, Article III.

ARTICLE VIII.*

LOCAL SECTIONS

Section 1.** Upon the application of ten or more members of the association residing in the same geographical district, or having offices therein, the executive committee shall organize a local section for that district, to which all members in that district shall be eligible. Such local section shall admit to active membership only members in good standing. It shall hold not less than two meetings each year, and shall be governed by such constitution and by-laws not inconsistent with the constitution of this association as the section membership may adopt and the executive committee approve.

Section 2. The parent association shall not be put under any obligation, either financial or in the matter of policy or opinion, by any local section.

ARTICLE IX.

AMENDMENTS

Section 1. This constitution may be amended at any regular meeting by a two-thirds vote of the members present, provided that notice of the proposed amendment or amendments has been sent to the members at least 30 days previous to said regular meeting.

By-Laws

TIME OF MEETING

1.** The regular meeting of this association shall convene annually during the month of September, the exact date to be fixed by the executive committee.

PLACE OF MEETING

2.** The place of holding the annual convention shall be Chicago, Ill.

3. It shall be within the power of the executive committee to change the location or time of the meeting if it becomes apparent that it is for the best interests of the association.

QUORUM

4. At the regular meeting of the association, 15 or more members shall constitute a quorum.

**DUES

5. The annual dues, for the fiscal year ending August 31, and payable in advance, shall be as follows:*

Members, $7.00; Associate Members, $7.00; Junior Members, $5.00.

DUTIES OF OFFICERS

6.† The president shall have general supervision over the affairs of the association. He shall preside at all meetings of the association and of the executive committee; shall appoint all committees not otherwise provided for, and shall be ex-officio member of all committees. He shall with the secretary sign all contracts or other written obligations of the association which have been approved by the executive committee.

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† Amended October 17, 1940.
* Article adopted 1922.
** Amended September 20, 1948.
‡ Amended September 21, 1957.

He shall render a detailed report at least three times during the year to the members of the executive committee, showing the financial condition of the association and its activities.

At the annual meeting the president shall present a report containing a statement of the general conditions of the association.

7. The vice-presidents in order of seniority shall preside at meetings in the absence of the president and discharge his duties in case of a vacancy in his office.

8.† It shall be the duty of the secretary to keep a correct record of the proceedings of all meetings of this association, and of all accounts, between this association and its members; to collect all moneys due the association, and deposit the same in the name of the association. He shall pay all bills when properly certified and approved by the president and the treasurer, and make such reports as may be called for by the executive committee. He shall also perform such other duties as the association may require.

9.‡ The treasurer shall have charge of the funds, check all deposits as made by the secretary, sign all checks after they have been approved by the president, and invest all funds not needed for current expenses as directed by the executive committee. He shall report at each annual meeting on the condition of the finances.

NOMINATING COMMITTEE

10.♯ After each annual meeting the president shall appoint a committee consisting of five members. Two Past Presidents shall be members of this committee, one of whom shall act as Chairman. No other officers of the Association shall be appointed to this committee. This committee shall prepare a list of names of nominees for officers to be voted on at the next annual convention in accordance with ARTICLE VI of the Constitution, said list to be read at the business session of said convention. Nothing in this section shall be construed to prevent any member making further nominations.

AUDITING COMMITTEE

11.‡ Prior to each annual meeting the president shall appoint a committee of three members, not officers of the association, whose duty it shall be to examine the accounts and vouchers of the secretary and the treasurer and certify as to the correctness of their accounts.

COMMITTEE ON SUBJECTS FOR DISCUSSION

12. After each annual meeting the president shall appoint a committee whose duty it shall be to prepare a list of subjects for investigation to be submitted for approval at the next convention.

COMMITTEE ON INVESTIGATION

13. After the association has adopted the list of subjects for investigation the president for the succeeding year shall appoint the committees who shall prepare the subjects for report and discussion. He may also appoint individual members to prepare reports on special subjects, or to report on any special or particular subject.

PUBLICATION COMMITTEE

14. After each annual meeting the executive committee shall appoint a publication committee consisting of three active members whose duty it shall be to cooperate with the secretary in the issuing of the publications of the association. The assignment of this committee shall be such that at least one member shall have served on the committee during the previous year.

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† Amended Ocotber 17, 1940.
‡ Adopted October 17, 1940.
* Amended June 22, 1964.
** Amended September 20, 1948.
♯ Amended December 4, 1950.

ORDER OF BUSINESS

15.† Call to order by president.
Opening prayer or invocation.
President's address.
Report of secretary.
Report of treasurer.
Appointment of special committees.
Reports of standing committees and presentation of papers.
Unfinished business.
New business.
Election of officers.
Installation of officers.
Adjournment.

DECISIONS

16. The votes of a majority of the members present shall decide any questions, motion or resolution which shall be brought before the association, unless otherwise provided. Unless specifically provided herein otherwise, all discussions shall be governed by Robert's rules of order.

AMENDMENTS

17.† The By-Laws can be amended by a two-thirds vote of those present at any regularly called executive committee meeting.

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† Amended September 20, 1948.

Two joint sessions were held—one on Monday morning, the other on Tuesday morning. Total attendance at conventions was 983 men.

DIRECTORY OF MEMBERS

As of October 15, 1965

HONORARY MEMBERS

E. H. Barnhart
R. E. Dove
N. D. Howard
T. H. Strate
E. C. Vandenburgh
L. C. Winkelhaus

LIFE MEMBERS

Arthur Anderson
J. L. Anderson
R. D. Anderson
J. H. Babbitt
H. L. Barr
J. F. Beaver
G. W. Benson
M. Block
W. C. Borchert
M. A. Bost
W. T. Brice
F. N. Budzenski
W. H. Bunge
E. E. Burch
A. E. Burford
C. M. Burpee
J. W. Carter
A. B. Chaney
H. B. Christianson
H. M. Church
P. B. Collier
A. A. Colvin
D. W. Converse
F. H. Cramer
E. T. Cross
H. D. Curie
H. H. Decker
H. M. Deih
J. V. Duchac
F. J. Duffie
Frank Duresky, Jr.
C. M. Eichenlaub
V. E. Engman
L. M. Firehammer
C. E. Forseth
R. L. Fox
H. C. Fronabarger
L. M. Frost
C. J. Geyer
F. E. Gladwin
A. M. Glander
A. A. Hampton
W. C. Harman
A. R. Harris
J. E. Heck
H. Heiszenbuttel
Birger Hemstad
B. M. Hickok
A. B. Hillman
F. W. Hillman
A. C. Hoyt
M. H. Hubbard
W. A. Hutcheson
V. W. Hutchings
J. V. Inabinet
T. E. Jackson
B. O. Johnson
D. H. Johnson
R. W. Johnson
A. C. Jones
W. G. Kemmerer
S. E. Kvenberg
J. W. Lacey
W. S. Lacher
H. L. Lord
L. A. Luther
L. E. Lyon
W. L. McDaniel
T. D. McMahon
H. C. Madson
B. F. Manley
D. A. Manning
W. F. Martens
S. K. Mason
W. G. Mateer
Lee Mayfield
W. R. Meeks
P. B. Merwin
I. A. Moore
A. B. Nies
W. J. O'Brien
W. C. Oest
W. H. Pahl, Jr.
W. V. Parker
N. E. Peterson
Andrew Pfeiffer
W. J. Phillips
C. Piccone
N. F. Podas
C. A. J. Richards
D. T. Rintoul
G. E. Robinson
O. F. Rowland
Fred Shobert
E. W. Singer
C. E. Smith
C. R. Taggart
E. R. Tattershall
P. V. Thelander
D. C. Todd
E. B. Tourtellotte
F. W. Truss
N. R. Tucker
J. L. Varker
T. M. von Sprechen
W. H. Walden
A. B. Wang
B. M. Whitehouse
H. O. Wray
J. E. Yewell
E. J. Zapfe

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A " Associate Member
J " Junior Member
L " Life Member
H " Honorary Member
(Figures following name indicate year in which membership became effective)

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The Conley Sliding Joints use a wing rail to relieve welded rail track expansion and contraction, which frequently causes track buckling, spreading, spike pulling, pull-aparts and other damages that interrupt traffic.

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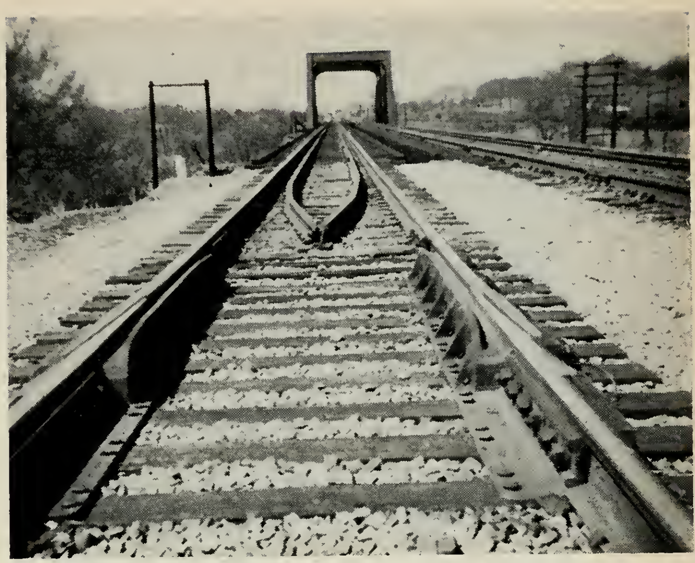

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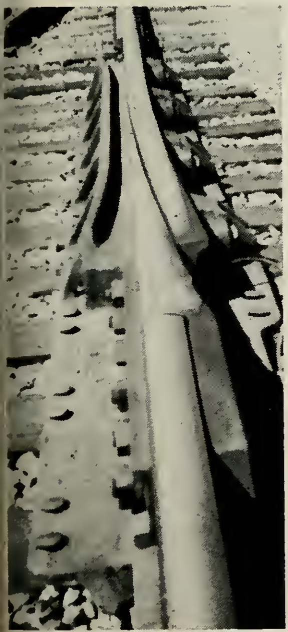

Take a good look at the above photo. It shows you how the Conley Sliding Joint wing rail moves to relieve expansion or contraction of welded track. The units require practically no maintenance.

Engineered for dependable operation and built for lasting ruggedness, Conley Sliding Joints effectively and positively compensate for the expansion and contraction of welded track rails.

The Conley Sliding Joint installation pictured above shows the heavy wheel tread provided at all times regardless of how much expansion, or contraction is taking or has already taken place. These sliding joints with extra heavy wheel-guide rails, weigh over 2,400 pounds each.

Each unit is complete within itself. Each one functions independently of the other. Each is fully automatic and responds solely to the variations induced by temperature changes — whether hot or cold. These joints are non-freezing, non-binding, non-locking and non-buckling. The sliding wing rails move only, if and when temperature changes.

Use Conley Sliding Joints on trestles, curves or in other critical locations where rail expansion and contraction must be relieved.

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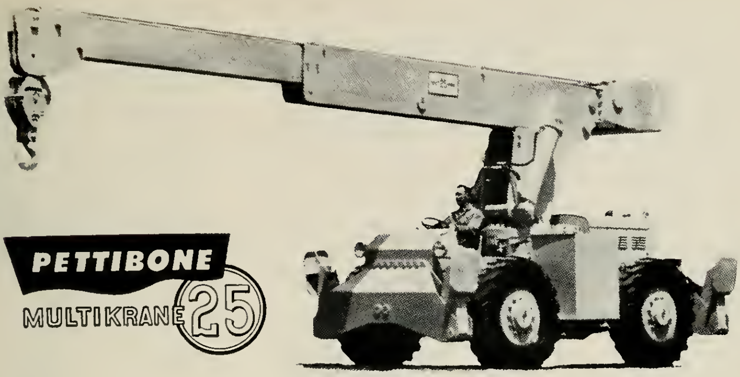

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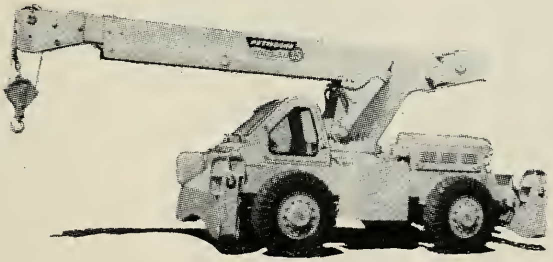

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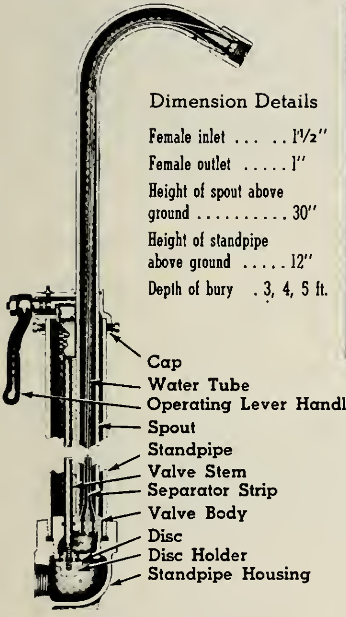
FAMOUS "840" NON-FREEZE HYDRANT



Dimension Details

Female inlet	1½"
Female outlet	1"
Height of spout above ground	30"
Height of standpipe above ground	12"
Depth of bury	3, 4, 5 ft.

The *FAMOUS "840" HYDRANT* is included in the "*LIST OF ACCEPTABLE INTERSTATE CARRIER EQUIPMENT HAVING SANITATION SIGNIFICANCE*" issued by the United States Public Health Service.

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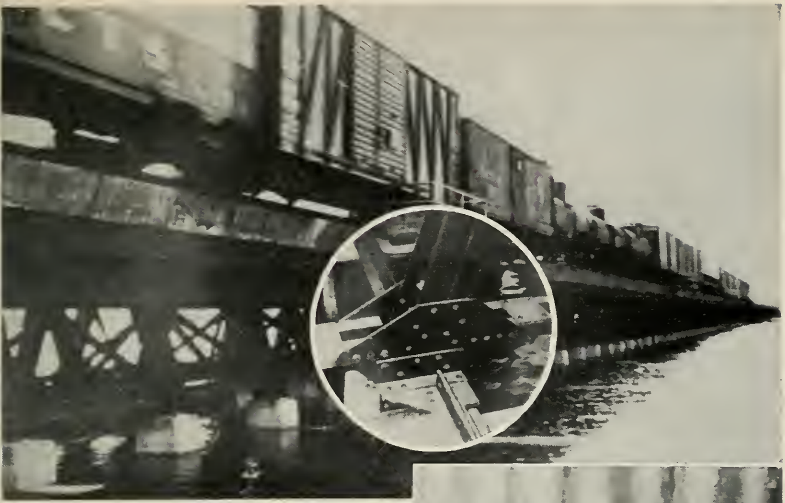

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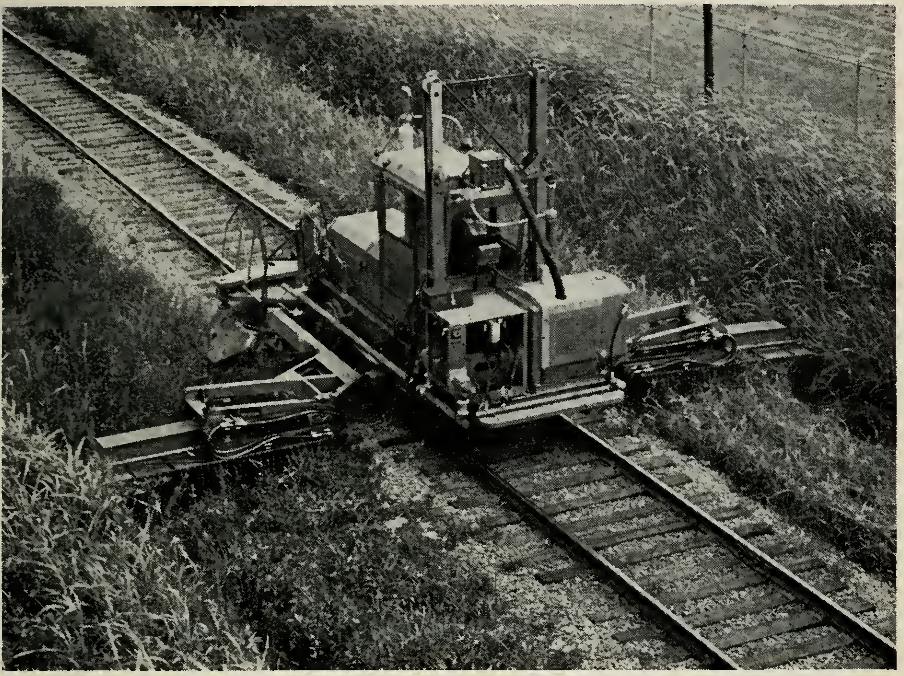

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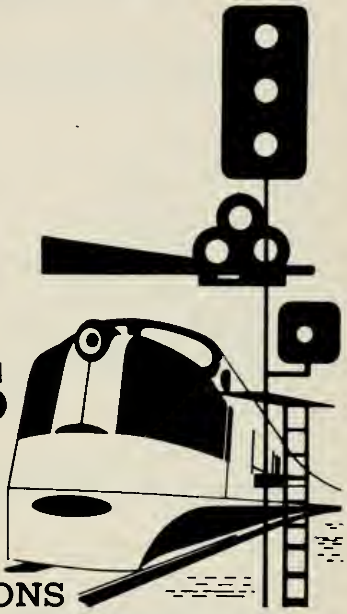

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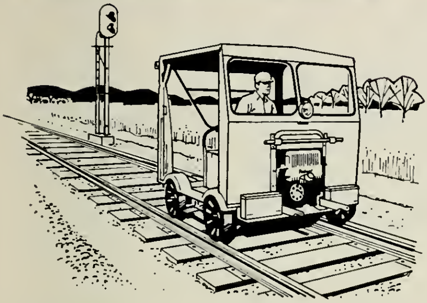

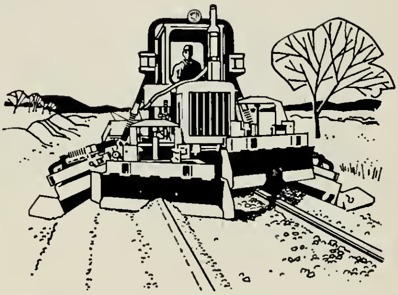

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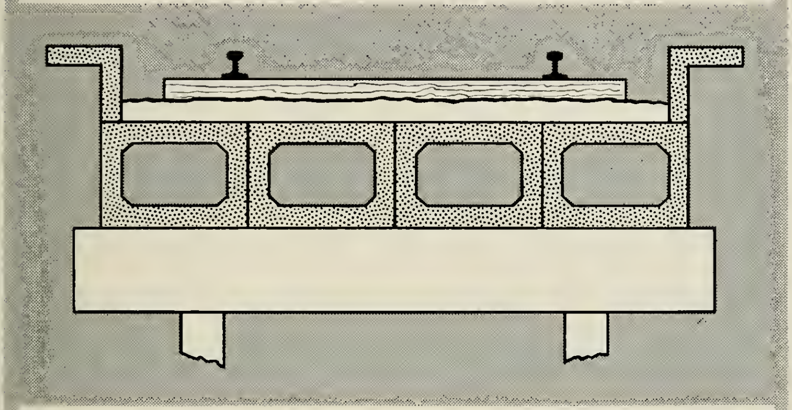

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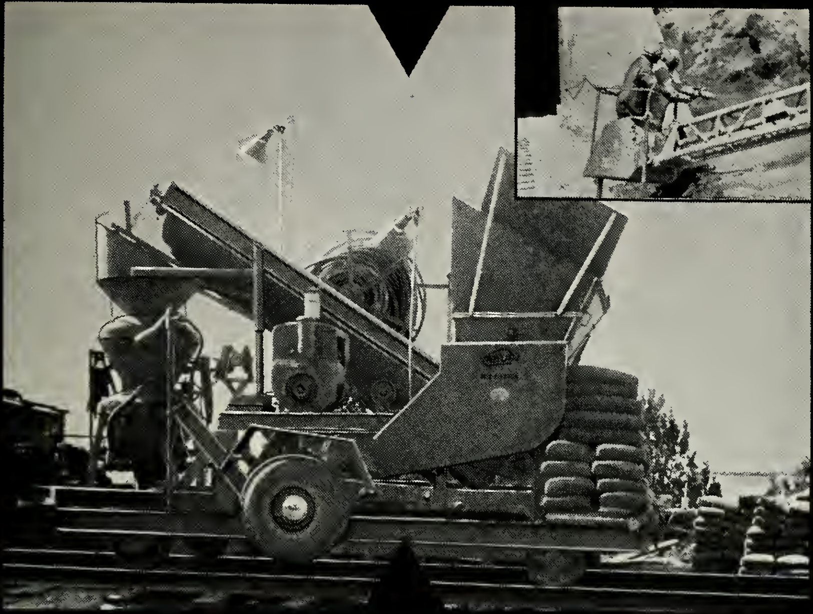

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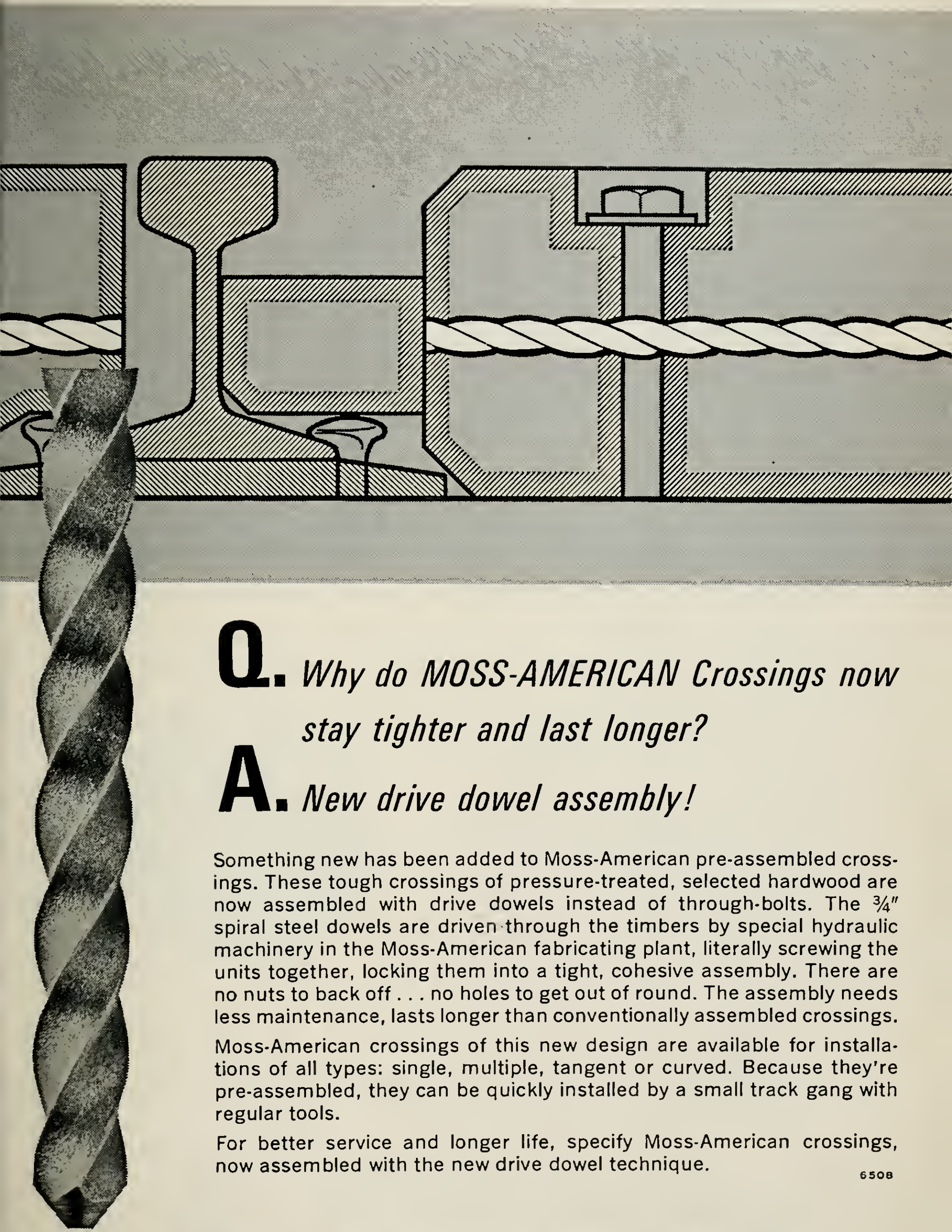

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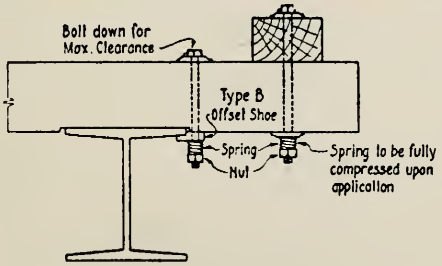
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